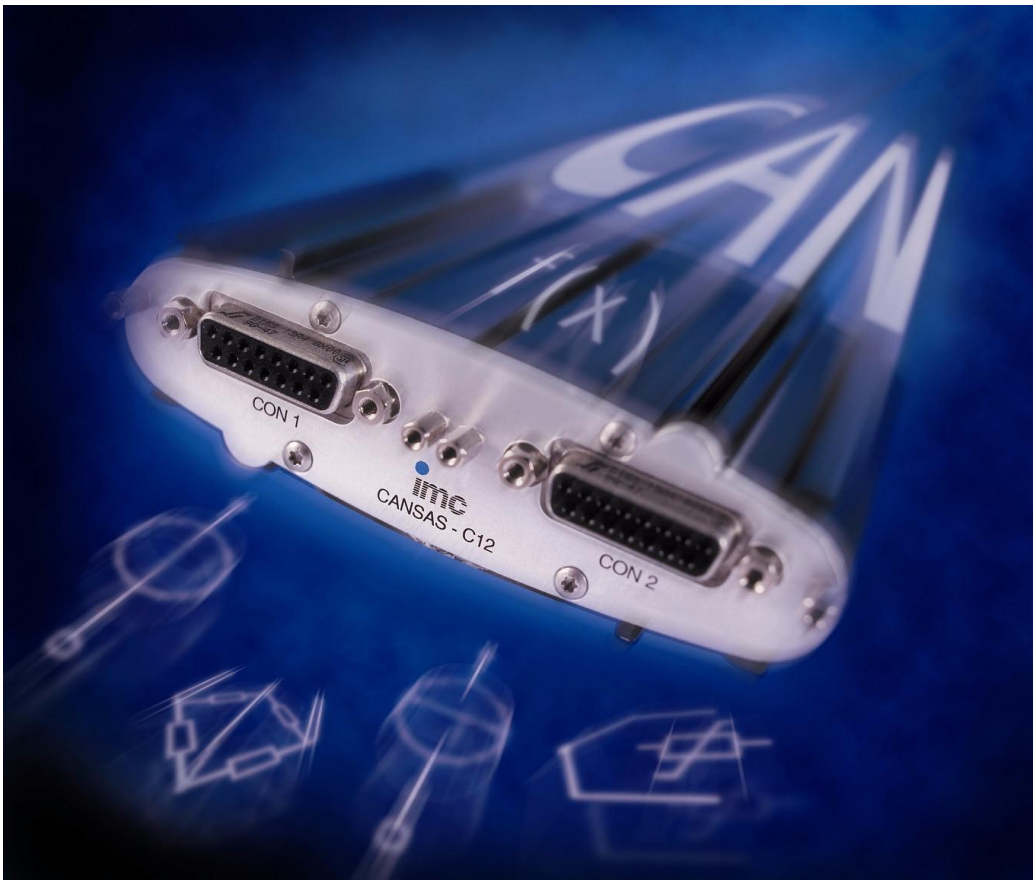
imc CANSAS 1.7

Configuring Software

Manual version 1.7 Rev 2	07.04.2011	**Users Manual**



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integrated measurement & control

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CANSAS

1.1 About this manual

In the first place, please accept our thanks for choosing our product! We wish you complete success in accomplishing your measurement goals using our *CANSAS* system.

This manual presents you with detailed description of *CANSAS'* features.

If you have any questions about our products which this manual does not answer, please contact our Customer Support department.

1.2 imc Customer Support - Hotline

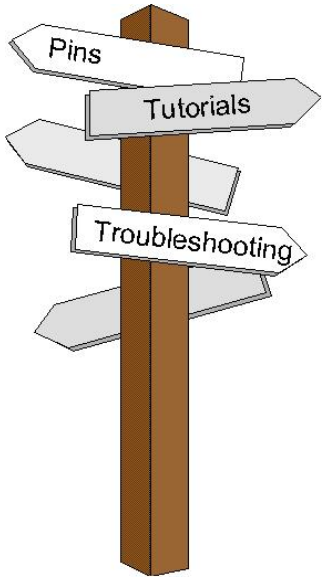
Germany:

imc Meßsysteme GmbH
Phone: ☎ 030 / 46 70 90 - 26
Fax: 🗐 030 / 4 63 15 76
WWW: www.imc-berlin.com
e-mail: hotline@imc-berlin.de

For our international partners see www.imc-berlin.com and click to ***International Distributors***

When requesting telephone consultation, please be prepared to state the serial numbers for your device and for your software's data carrier, and have this manual present. Thanks!

1.3 Guide to using the manual



WHERE ?	Will you find **WHAT?**	**Contents overview**
	Instructions - You *really* should read this!	
Ch. 1	Required reading! 22	Important information, Safety Notes, License Contract, Requirements
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Regularly updated information and up-to-date user's manuals can be accessed on www.imc-berlin.com.

1.4 Guidelines

1.4.1 Certificates and Quality Management

imc holds DIN-EN-ISO-9001 certification since May 1995.

Current certificates and information about the imc quality system can be found on the WEB
http://www.imc-berlin.de/en/Customer Support/Quality Assurance

For further information, please contact our hotline 16.

1.4.2 imc Guarantee

Subject to imc Meßsysteme GmbH's general terms and conditions.

1.4.3 ElektroG, RoHS, WEEE

The company imc Meßsysteme GmbH is registered under the following number:

WEEE Reg.- # DE 43368136

Brand: imcDevices

Category 9: Monitoring and control instruments exclusively for commercial use

Valid as of 24.11.2005

Our products fall under Category 9, "Monitoring and control instruments exclusively for commercial use" and are thus at this time exempted from the RoHS guidelines 2002/95/EG.

The law (ElektroG) governing electrical and electronic equipment was announced on March 23, 2005 in the German Federal Law Gazette. This law implements two European guidelines in German jurisdiction. The guideline 2002/95/EG serves "to impose restrictions on the use of hazardous materials in electrical and electronic devices". In English-speaking countries, it is abbreviated as "RoHS" ("Restriction of Hazardous Substances").

The second guideline, 2002/96/EG "on waste electrical and electronics equipment" institutes mandatory acceptance of returned used equipment and for its recycling; it is commonly referred to as WEEE guidelines ("Waste on Electric and Electronic Equipment").

The foundation "Elektro-Altgeräte Register" in Germany is the "Manufacturers' clearing house" in terms of the law on electric and electronic equipment ("ElektroG"). This foundation has been appointed to execute the mandatory regulations.

1.4.4 CE Certification

Conformity Declaration

imc
integrated measurement & control

imc Meßsysteme GmbH
Voltastraße 5, D-13355 Berlin,

hereby declares that our product

imc CANSAS

in all its model varieties

conforms to the following applicable standards: [1,2]

EC Low Voltage Directive 2006/ 95/EEC*
(implemented in Germany as the 1[st] regulation of the Device And Product Safety Law GPSG)

EMC Directive 2004/108/EEC
(implemented in Germany as the EMC-Law EMVG)

The system was designed, constructed and tested in accordance with the regulations delineated in

Safety Regulations for electric measurement, open and closed-loop control and laboratory devices DIN EN 61 010-1:2002

and was subjected to a thorough routine test before shipment and left the production facility in perfect condition[3].

Berlin, 2008-JAN-04
Place and date of issue

Dipl. Ing. Josef Schwan
Production Department Head

Dipl. Ing. Michael Scheibner-Aden
Quality Assurance Manager

[1] *This conformity declaration pertains fundamentally only to the system as delivered by imc. The user is solely responsible for alterations and expansions as well as for ensuring the altered system's compliance with the applicable EC-directives.*

[2] ***Harmonized standards:***
DIN EN 61326:2004 (product standard): conforms to requirements for electromagnetic immunity measurements of equipment intended for industrial use (as per EN 61326/ table A1) and for Radio Interference Intensity Class A (EN 61326 table 3).
DIN EN 61000-4-2:2001, -4-3:2003, -4-4:2002, -4-5:2001, -4-6:2001 DIN EN 55011:2003

DIN EN 61010-1:2002

[3] ***Quality management**: imc holds DIN-EN-ISO-9001 certification since May 1995. imc's conformity to the world-wide accepted standard DIN EN 9001:2000 is attested to by the Certificate issued July, 2006 by the accredited TÜV CERT certification body of TÜV Anlagentechnik GmbH. imc's certificate registration number is 01 10085152.*

1.4.5 Product improvement

Dear Reader!

We at **imc** hope that you find this manual helpful and easy to use. To help us in further improving this documentation, we would appreciate hearing any comments or suggestions you may have.

In particular, feel free to give us feedback regarding the following:

- Terminology or concepts which are poorly explained
- Concepts which should be explained in more depth
- Grammar or spelling errors
- Printing errors

Please send your comments to the following address:

imc Mess-Systeme GmbH
Customer Service Department
Voltastrasse 5
D - 13355 Berlin

Telephone: 0049 - 30 - 467 090 - 26
Telefax: 0049 - 30 - 463 15 76
e-mail: hotline@imc-berlin.de

1.4.6 Important notes

1.4.6.1 Remarks Concerning EMC

CANSAS satisfies the EMC requirements for unrestricted use in industrial settings.

Any additional devices connected to *CANSAS* must satisfy the EMC requirements as specified by the responsible authority (within Europe[2]) in Germany the BNetzA - "Bundesnetzagentur" (formerly BMPT-Vfg. No. 1046/84 or No. 243/91) or EC Guidelines 2004/108/EEC. All products which satisfy these requirements must be appropriately marked by the manufacturer or display the CE certification marking.

Products not satisfying these requirements may only be used with special approval of the regulating body in the country where operated.

All signal lines connected to *CANSAS* must be shielded and the shielding must be grounded.

Note

The EMC tests were carried out using shielded and grounded input and output cables with the exception of the power cord. Observe this condition when designing your experiment to ensure high interference immunity and low jamming.

Reference

See also *General Notes \ Precautions for operation \ Grounding, shielding \ Shielding*

[2] *If you are located outside Europe, please refer the appropriate EMC standards used in the country of operation.*

1.4.6.2 FCC-Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules (CFR 15.105)[3]. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio or television technician for help.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by **imc** may void the user's authority to operate this equipment.

[3]*FCC - United States Federal Communications Commission*

1.4.6.3 Cables

Connections to this device must be made with shielded cables with metallic RFI/EMI connector hoods to maintain compliance with FCC Rules and Regulations.

1.4.6.4 Other Provisions

This equipment has been carefully designed, manufactured and individually tested. It has been shipped in a condition in complete compliance with the various safety standards and guidelines described in the CE Certification.

Industrial Safety

We certify that *CANSAS* in all product configuration options corresponding to this documentation conforms to the directives in the accident prevention regulations in "Electric Installations and Industrial Equipment" (BGV-A3 of the Index of Accident Prevention Regulations of the Professional Guilds in Germany).

This certification has the sole purpose of releasing imc from the obligation to have the electrical equipment tested prior to first use (§ 5 Sec. 1, 4 of BGV-A3). This does not affect guarantee and liability regulations of the civil code.

1.5 Important information

Required Reading!

1.5.1 Safety Notes

If you have any questions concerning whether or not you can use this device in its intended environment, please contact **imc** Customer Service.

The device has been carefully designed, assembled and routinely tested in accordance with the pertinent safety regulations and has left **imc** in perfect operating condition. To maintain this condition and to ensure continued danger-free operation, the user should pay particular attention to the remarks and warnings made in this chapter. In this way, you protect yourself and prevent the device from being damaged.

The technical specifications claimed in this manual are valid for 1 year after delivery under normal operating conditions. Be careful to observe the specified operating temperature range.

Read the instructions *before* turning the device on for the first time! Retain and attend to any configuration booklet which may have been included with this manual.
Knowledge of the module type and its pin configuration is essential to operation.

The rated technical specifications presented in the chapters of this manual are valid for 1 year after delivery of the system under normal operating conditions. Observe the specified ambient temperature conditions.

1.5.1.1 Special Symbols Used in this Manual

The following symbols have been used in this manual:

Caution! **and** **Attention!**

Pay particular attention to texts marked with this symbol. Failure to observe this warning may lead to personal injury, cause damage to the device/ system or lead to the loss of data.

Hint **and** **Remarks**

General or helpful advice pertaining to the current topic. The hints often contain tips relevant to practical applications.

The Remarks symbol is followed by general or additional information pertaining to a specific topic.

1.5.1.2 Symbols displayed on the device

The following symbols appear on the CANSAS device:

Caution! Refer to the User's Manual. This symbol advises the user to consult the User's Manual for more information concerning possible dangers.

Danger of electrostatic discharge. Electrostatic sensitive devices, which are any electronic components at risk of damage due to electrostatic discharge (ESD), are marked by this symbol.

ESD WARNING!
Despite protective measures, our components are sensitive to electrostatic discharge. Electrostatic charge may accumulate unnoticed and may even cause damage without your being immediately aware of it. Such damage can be avoided by carrying out all work at "safe" work stations and by utilizing packaging with electrostatic shielding when transporting sensitive components.
Always follow ESD precautions!

CAUTION!
When handling static sensitive devices, observe the following guidelines:

- Always statically discharge yourself (e.g. by touching a grounded object) before handling static sensitive devices.
- Any equipment and tools used must also be free from static charge.
- Unplug the power cord before removing or inserting static sensitive devices.
- Handle static sensitive devices by their edges.
- Never touch a connection pin or conducting track on static sensitive devices.
- ***Always ensure that electrostatic charge does not form at contacts between device sockets and their leads. Any charge which may develop here is to be lead off. Damage resulting from ESD is not covered in the guarantee.***

1.5.1.3 Transporting CANSAS

When transporting the CANSAS module, always use the original packaging or an appropriate packaging which protects the device against knocks and jolts. Above all, never let the module fall. If transport damage occurs, please be sure to contact the imc customer service.

Possible damage due to condensation can be limited by wrapping the device in plastic sheeting. For more on this topic, see the notes under *Before Starting* 24.

1.5.1.4 Shipment

- CANSAS module according order
- Calibration certificate as per DIN EN ISO 9001
- Instruction manual CANSAS modules
- With strand-cast aluminum housing: Connection terminal for power supply via Phoenix socket or via LEMO socket with gum sealing ring at SL models

1.5.1.5 After Unpacking...

Please check the device for mechanical damage and/ or loose parts after unpacking it. The supplier must be notified immediately of any transportation damage! Do not operate a damaged device!

Note that a CANSAS module must be configured before being taken into operation!

1.5.1.6 Guarantee

Each device is subjected to a 24-hour "burn-in" before leaving imc. This procedure is capable of recognizing almost all cases of early failure. This does not, however, guarantee that a component will not fail after longer operation. Therefore, all imc devices are guaranteed to function properly for ***one year***. The condition for this guarantee is that no alterations or modifications have been made to the device by the customer.

1.5.1.7 Before Starting

Condensation may form on the circuit boards when the device is moved from a cold environment to a warm one. In these situations, always wait until the device warms up to room temperature and is completely dry before turning it on.

We recommend that you allow an approx. 30 min. warm-up phase before starting a measurement.

The module has been designed for use in clean and dry environments. They are not to be operated in 1) exceedingly dusty and/ or wet environments, 2) in environments where danger of explosion exists nor 3) in environments containing aggressive chemical agents.

Always arrange your cables and signal leads in a safe fashion. Think prevention!

Never connect or disconnect signal leads during thunderstorms.

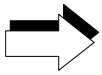
1.5.1.8 General Safety

Certain basic rules of safety are always to be followed, even with 'safe' devices such as CANSAS. Unintended and/ or inappropriate usage of the device can be dangerous for the operator and/or surrounding persons and, in the worst case, can damage the test object or CANSAS itself. We strongly discourage the user from making any modifications to the measurement system whatsoever. Doing so can be especially dangerous because other users may be unaware of the changes.

If you determine that the device cannot be operated in a non-dangerous manner, then the device is to be immediately taken out of operation and protected from unintentional use. Taking this action is justified under any of the following conditions:
the device is visibly damaged,

- loose parts can be heard within the device,
- the device no longer functions properly,
- the device has been stored for a long period of time under unfavorable conditions (e.g. outdoors or high-humidity environments).

1. Always wait a few seconds before turning the device back on after it has been turned off. A general test of the system (e.g. voltages, operating condition, memory test) is performed during the boot sequence.
2. **WARNING!** Opening the housing or removing any parts not normally removable by hand can expose dangerous voltages. Always turn the device off and unplug the power supply before doing so!
3. It is strictly forbidden to repair or adjust an opened device which is plugged in. And if such work is *absolutely* necessary, then only specially trained personnel who are fully familiar with the procedures to be used may carry this out.

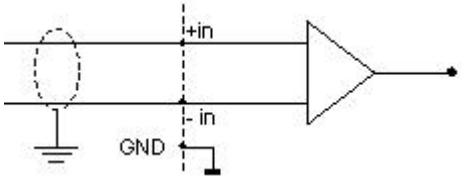


Reference

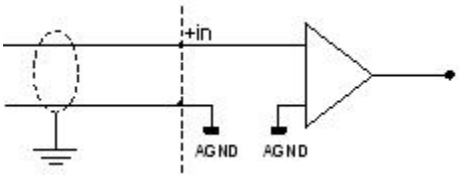
See also "Troubleshooting 25", in this chapter. Please refer to the specifications in the Appendix and the application hints for the different CANSAS modules for information on avoiding damage to the device due to inappropriate signal connection.

☞ **Note**

Be sure to shield and ground the input and output cables properly. Connect the measurement signals as shown below to make measurements in compliance with the EMC guidelines:



Differential measurement



Single-ended measurement

For potential-isolated amplifier inputs it may be necessary to use double shielding.

1.5.1.9 Maintenance and Service

Your CANSAS device requires no special maintenance.

The listed maximum error is valid for one year after delivery under normal operating conditions (pay attention the operating temperature).

Various important properties of the device should be monitored at regular intervals. We recommend annual calibration, which consists of an overall checkup of device operation. Our distribution outlets can quote you the price for having your system calibrated in accordance with DIN EN ISO 9001.

When returning the device in connection with complaints, please include a written, outlining description of the problem, including the name and telephone number of the sender, and a print-out of the configuration. This will help expedite the process of problem elimination.

For questions by telephone please be prepared to provide your device's serial number and have your installation CD, as well as this manual at hand, thanks!

A contract for system calibration can -per agreement- include a software update.

1.5.1.10 Cleaning

Watch Out

Always unplug the power supply before cleaning the device. Only qualified service technicians are permitted to clean the housing interior.

Do not use abrasive materials or solutions which are harmful to plastics.

Do not allow liquids to enter the housing interior.

Use a dry cloth to clean the housing. If the housing is particularly dirty, use a cloth which has been slightly moistened in a cleaning solution and then carefully wrung out.

To clean the corners, slits etc. of the housing, use a small soft dry brush.

1.5.1.11 Troubleshooting

Only qualified technicians are allowed to make repairs on the device! Unauthorized opening or incorrect repair of the device may greatly endanger the user (electric shock, fire hazard). Devices which have been altered or tampered with no longer comply with their license and may not be used. In case of accident (e.g. damage to housing, terminals, modules or power supply, or exposure to liquids or foreign substances), turn the device off immediately, unplug the power cord and inform **imc**'s Customer Service.

1.6 Hardware requirements

- IBM - (or 100%-compatible) AT with Pentium processor or higher.
- Minimum 150MByte free hard drive memory.
- CD-ROM drive (for installation)

1.7 Software requirements

Installation can be accomplished using the following operating systems (administrator authorizations required):

- Microsoft Windows XP (32 Bit)
- Microsoft Windows Vista (32 Bit)
- Microsoft Windows 7 (32 or 64 Bit)

No guarantee is extended that this product will work under future versions of the operating system.

Additional limitations imposed by the manufacturer of the CAN-bus card used in your PC are possible.

Startup

2.1 CD-Contents

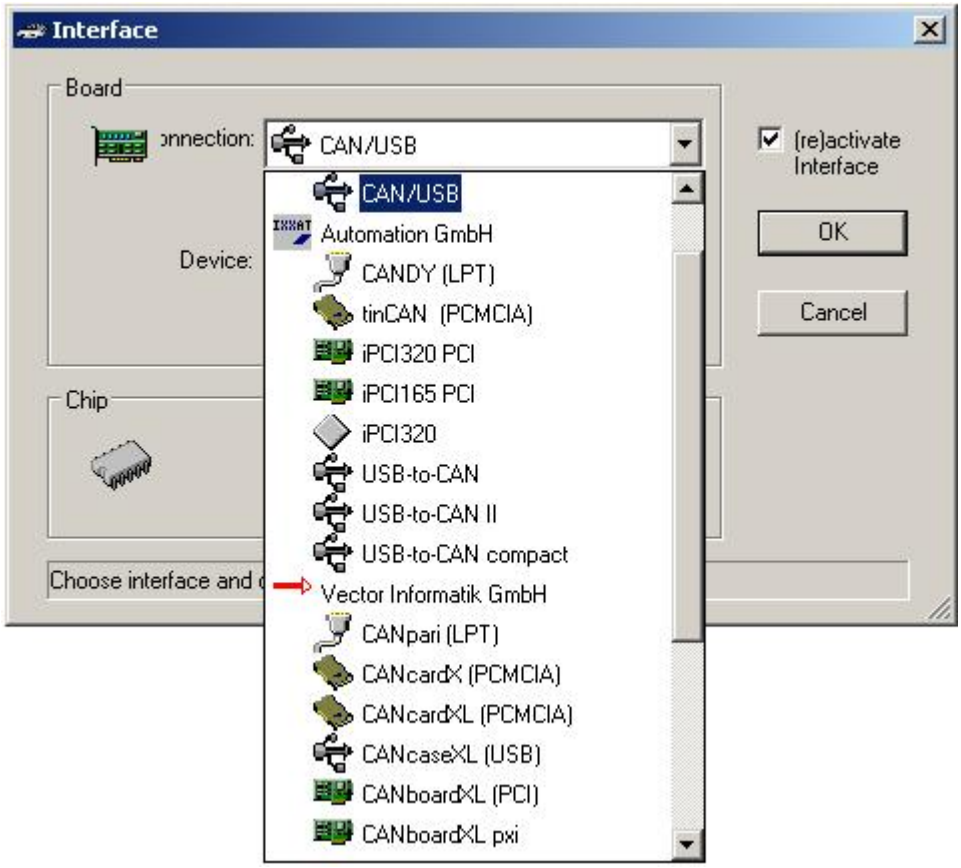
2.1.1 Setup-Program

The root directory on the CD contains the file SETUP.EXE. Call this program in order to install the CANSAS configuration software.

2.1.2 Driver-software for the PC / CAN-Bus interface

The CANSAS application supports different types of interface cards. The driver software corresponding to the card used can be found on the CD in the directory *Driver*.

2.2 Interface cards



The interface card or adapter types supported by CANSAS at this time are produced by the companies imc, Vector, dSpace, KVASER, XXAT and HORIBA. Their installation and support software is located in the directory *Driver.* The directory is subdivided for the different companies' interface types.

The functionality is provided by the manufacturer of the interface card or adapter. Please check the internet page of the manufacturer for driver updates also.

At present for Windows 64 bit, interfaces for CANSAS are supported by imc and KVASER.

2.2.1 IXXAT interface cards

For Windows7 64bit CANSAS does not support any interface cards from IXXAT.

CANSAS can be used in conjunction with the IXXAT company's ISA plug-in card *iPC-I320*, the PCI card *iPC-I320 PCI* or the PC-Card plug-in *tinCAN* (PCMCIA).

See IXXAT's instructions included with the respective card for info on installing the card under WindowsXP or Windows7

To install the card for use under the operating systems WindowsXP or Windows7, IXXAT's operating system-specific *VCI driver installation* must be used. The VCI-installation must proceed according to the IXXAT installation instructions.

The **additional installation** of this driver software is **absolutely necessary** for use of the card with CANSAS! An IXXAT programming interface is automatically installed along with the driver, which is meant for using the driver directly to create one's own Windows applications. But this is not a CANSAS programming interface and thus not relevant for users of CANSAS software!

The VCI-setup includes all IXXAT card drivers, so after VCI-installation, any IXXAT interface should be ready for use. As part of the installation, an item "*IXXAT Interfaces*" is set up in the Windows Control Panel. In this control program, all IXXAT interfaces can be set up and tested.

The VCI package also includes the installation of a monitoring program MINMON32, which is able to communicate with the CAN-Bus via any IXXAT interface card. This may be helpful for installing an IXXAT interface card if its setup is causing problems with, for instance, selecting IRQs, or I/O memory depth etc. By mean of this program it's also possible to perform a function check of the card.

Note that IXXAT sometimes provides a Service Pack for additional installation along with the VCI basic package for debugging purposes. This is the case, for example, with VCI Version 2.10. Further information on the VCI-package can be found at the IXXAT web site *http://www.ixxat.de* in the Internet. The most current VCI driver software can also be obtained there as a download. Some of the instructions and tips presented at that site are also on the CANSAS-CD as PDF-files in the folder *\Driver\Ixxat*.

If the target PC already has older VCI driver software of type 1.x installed on it, it can, in principle, be used with CANSAS, so that updating to VCI 2.x isn't necessary. But if the VCI version is to be updated, observe the instructions file *Update to new version of VCI.doc* in the folder *\Driver\Ixxat* on the CD. The same applies if older card drivers are to be replaced by those which come with VCI 2.x. For such cases, it may be helpful to use the auxiliary cleaner program *Vciclean.exe* located on the CD.

2.2.2 dSPACE interface cards

Please follow instructions of the http://www.dSPACE.com manual.

2.2.3 KVASER interface cards

CANSAS works with the KVASER -driver package 4.2, that has been released for XP-32/64 without problems for XP 32/64 and for Win7-32/64. For Win7-32/64 it is necessary to install the firmware 3.3 or higher to the USB interface.

The newer driver package 4.4 caused instabilities with CANSAS.

2.2.4 Vector interface cards

For Windows7 64bit CANSAS does not support any interface cards from Vector.

Both the PC-Card *CANcardX* (PCMCIA) and the parallel port dongle *CANpari* are supported by CANSAS.

See the corresponding instructions provided by Vector on installing the cards under the operating systems WindowsXP or Windows7. To use the card, the Vector driver installation appropriate to both the interface and operating system type must be used. This can be found on the CD in the folder *\Driver\Vector.* However, it is preferable to use the current driver diskette which comes with the card. Installation of the driver is **absolutely necessary** for the card to support the CANSAS software!

Note that the Vector driver diskette often comes with an updated file named *Vcan32.dll*. This serves as a

link for applications which want to use the card driver. This file is usually not automatically copied onto the PC by the Vector driver installation and must be copied from the diskette to the CANSAS directory 'manually'! See Vector's instructions file for the driver installation, usually designated *Readme.txt*.

Installing the Vector driver adds an item "*CAN Hardware*" to the Windows Control Panel. This control program can be used to test any Vector interface. Otherwise, the program's functions aren't needed for running the CANSAS software.

For Windows7 CANSAS can work with the XP-Legacy-driver (from 2003-2006). They also run with Win7-32bit.

The current driver package **7.x**, for Win 7-32/64 is not supported by CANSAS!

Further information on the Vector cards can be found at the Vector web site *http://www.vector-cantech.com* in the Internet. The most current driver software can also be obtained there as a download. Some of the instructions and tips presented at that site are also on the CANSAS-CD as PDF-files in the folder *\Driver\Vector*.

2.3 imc interface adapter

The CANSAS configuration software can use a USB adapter by imc for access to the CAN-Bus. Installation of the driver is accomplished by means of Window's Plug'n'Play functionality. The driver is located under \Driver\Imc on the CD. The interface can be used on all Windows operating systems which are USB-supported.

2.3.1 Installation of the imc-CAN/USB Adapter

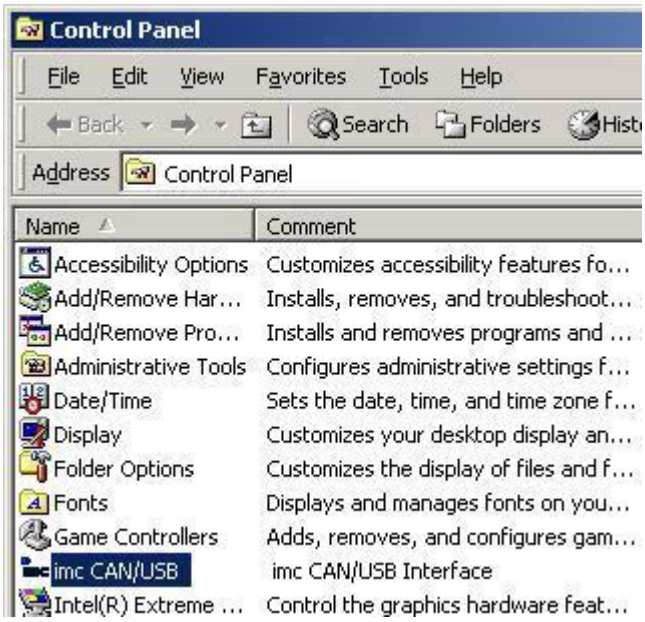
For the imc-CAN/USB Adapter to work properly, the driver which matches the configuration software must be installed. To do this, start the file imCanUSB.exe. on the installation-CD under */Driver/Imc/imCanUsb/*, which correctly installs the driver.

Note

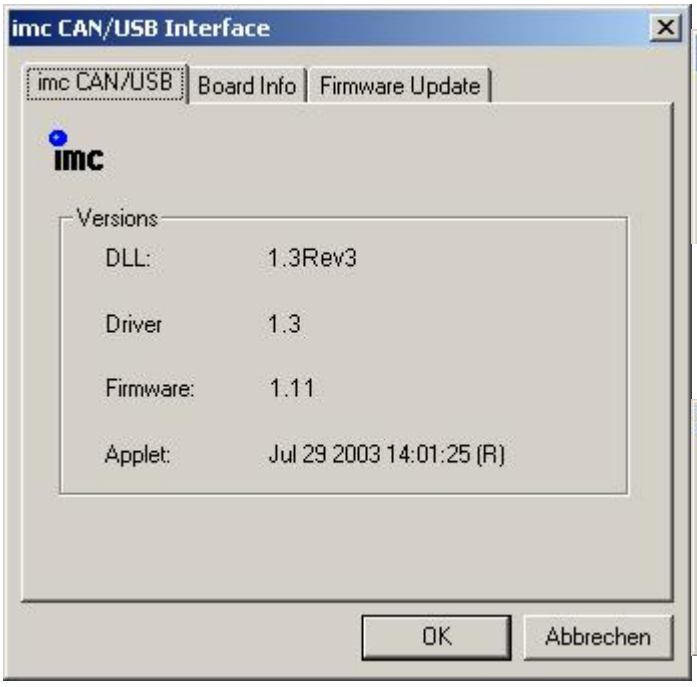
- After installing the CANSAS software, a message appears to install the matching CAN/USB driver. It's very important to run that installation. Connect the CAN/USB adapter only after the installation has been finished successfully (including reboot of WINDOWS). You must have administrator rights. Otherwise it may seem that the driver has been installed, but it won't work properly!
- Even if you have an older version of the configuration software with a functioning imc-CAN/USB connection, when you update the configuration software you must install the matching USB driver!
- From Version 1.3 Rev8 on, driver installation is started automatically after installation of the configuration software. Unfortunately, this happens so quickly that the two installation windows overlap. That means that the prompt "Restart computer" already appears before the driver installation has been completed. In this case, use the combination of the keys [ALT] and [TAB] to bring the driver setup's dialog into the foreground and follow the instructions. Then the PC is restarted.
- If you connect the CAN/USB interface to your PC without installing the matching driver before, Windows will use a default driver. Don't use that. That driver can't run CAN/USB properly. In case that driver has been selected, contact imc customer service.

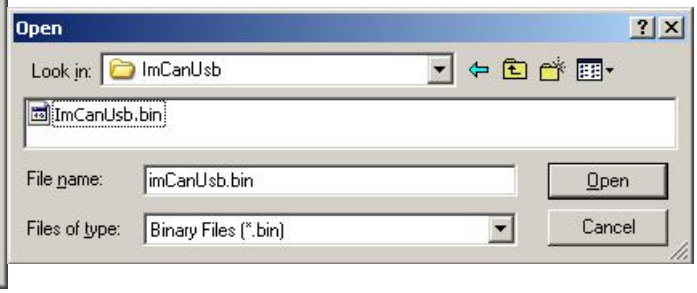
2.3.2 Firmware of the imc-CAN/USB Adapter

If problems arise despite proper installation of the USB-driver as described, you can get a readout of the version via *Settings / Control panel /imc CAN/USB*. This is useful, for instance, in order to inform our hotline of the problem.


Control Panel
File Edit View Favorites Tools Help
Back Search Folders
Address Control Panel
Name Comment
Accessibility Options Customizes accessibility features fo...
Add/Remove Har... Installs, removes, and troubleshoot...
Add/Remove Pro... Installs and removes programs and ...
Administrative Tools Configures administrative settings f...
Date/Time Sets the date, time, and time zone f...
Display Customizes your desktop display an...
Folder Options Customizes the display of files and f...
Fonts Displays and manages fonts on you...
Game Controllers Adds, removes, and configures gam...
imc CAN/USB imc CAN/USB Interface
Intel(R) Extreme ... Control the graphics hardware feat...

Here you can also write new firmware into the adapter. The appropriate firmware can be found on the installation-CD for the configuration software under */Driver/Imc/imCanUsb/imCanUsb.bin.*





2.4 CANSAS software installation

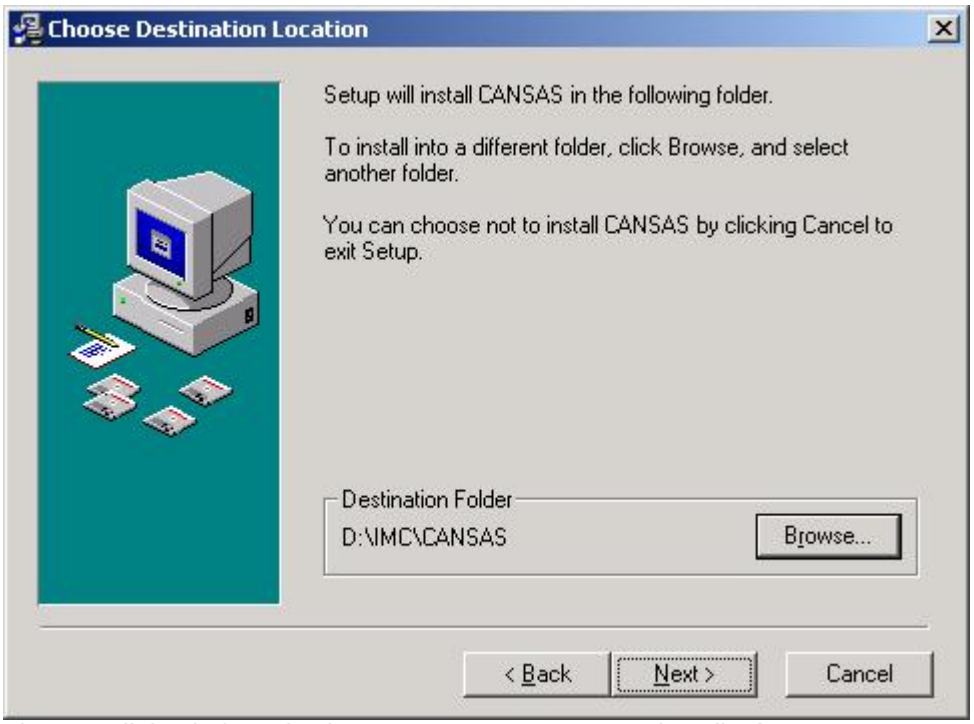
The software included for installing the CANSAS-module is on CD-ROM. The software is started by running the file "Setup.exe".

The supported operating systems are listed here 26.

The installation process includes updating of the following drivers:

- MS DAO
- MS-Jet Engine
- MS OLE Automation
- Crystal Records
- Microsoft XML Parser

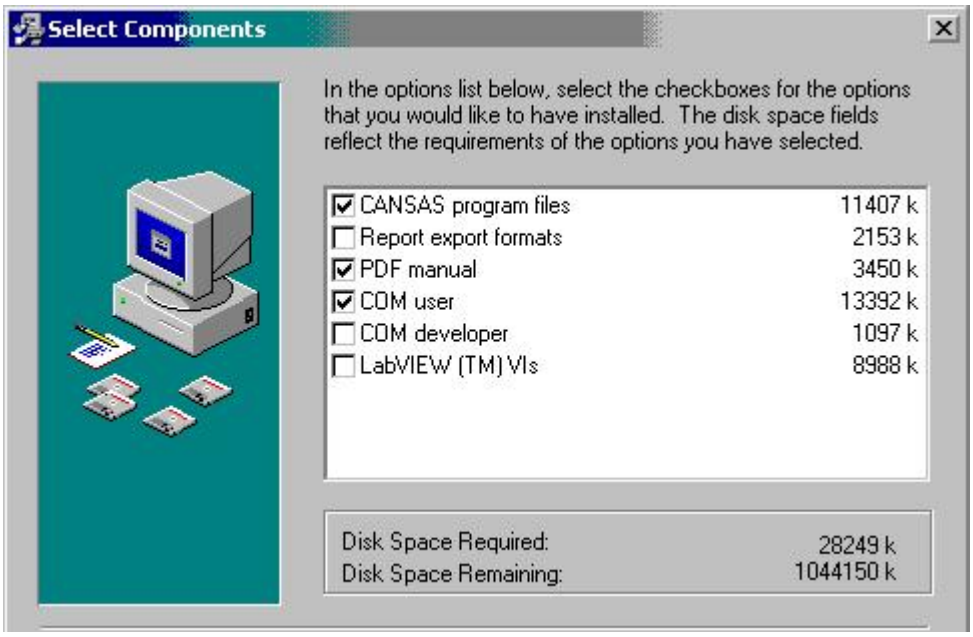
The installation offers both a German and an English version of the software; make the choice in the first dialog which appears. The **second** dialog displays legal provisions and instructions on completing the installation procedure. The **third** dialog prompts the user to specify the installation folder's location. All files needed for running the CANSAS-module are then copied into this folder.


Choose Destination Location
Setup will install CANSAS in the following folder.
To install into a different folder, click Browse, and select another folder.
You can choose not to install CANSAS by clicking Cancel to exit Setup.
Destination Folder
D:\IMC\CANSAS
Browse...
< Back
Next >
Cancel

The next dialog is for selecting program components to install. The *CANSAS Program files* must be retained as active since they are essential for configuring CANSAS. The component *Report Export formats* only needs to be installed if a CANSAS report on module configurations is to be saved in an extraneous format, such as in the form of an Excel file.

The *COM user* interface offers access to all functions when using a created program, e.g. by Visual Basic or C++.

If you are going to develop your own programs, you should select *COM developer.* This option comes with an online-help and examples. To develop using LabVIEW select the option *LabVIEW ™ Vis.*

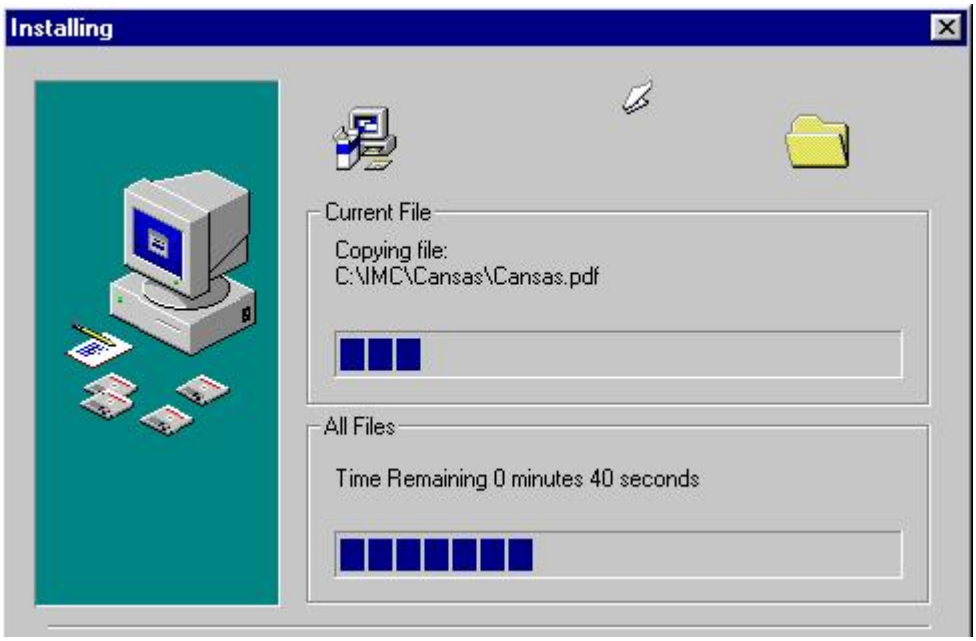

Select Components
In the options list below, select the checkboxes for the options that you would like to have installed. The disk space fields reflect the requirements of the options you have selected.
CANSAS program files 11407 k
Report export formats 2153 k
PDF manual 3450 k
COM user 13392 k
COM developer 1097 k
LabVIEW (TM) VIs 8988 k
Disk Space Required: 28249 k
Disk Space Remaining: 1044150 k

Note

Installation of CANSAS does not serve to change a previous installation in terms of simply exchanging selected components. Instead, installation is carried out from scratch, completely. It is recommended to completely uninstall any previously present CANSAS software, particularly older versions, before installing new software! However, before uninstalling old software, any user's data stored in the program folder should be saved to other memory space or they will be lost. Such data are located in database files, for instance, under the name *Imcan.mdb.*

The next dialog is for selecting the program group which contains the shortcut icon for starting the module.

A progress indicator bar is displayed during the actual installation process, indicating the extent of progress and which files are currently being copied.



The last dialog announces successful installation. If, however, the "Common Controls" are too old for the CANSAS software, the installation continues with the Microsoft installation of the common controls. This may make it necessary to reboot the computer.

2.5 Connections

2.5.1 CAN connection for the PC

The access for CAN to the PC is provided via an ISA-bus card, PCI-bus card, PCMCIA-card, or a USB or parallel port adapter.

To install the card or adapter, please observe the notes and instructions in the booklet which comes with the card and use the corresponding driver diskette. Alternatively, the driver software located under the folder *Driver*\.. on the CANSAS-CD-ROM can be used, as described at the beginning of this chapter. However, it is possible that the driver installation on the CANSAS CD doesn't represent the most current version of the card driver.

2.5.2 CAN connection to CANSAS

The CANSAS-module possesses a full-grade CAN (Controller Area Network) connection for transmitting measurement data, and can send messages at up to 1MBit/s. The CAN-connection is a node on the CAN-Bus, to which any number of CAN-devices can be connected.

The CAN-Bus can be considered a sort of line. The beginning consists of a CAN-Bus-terminator, which is connected to the first node either directly or via a serial cable. The second node is connected to the first via another serial cable, etc. After the last node, there is another CAN-Bus-terminator.

The serial cables used are commercially available, plated-through cables for the PC's serial interface.

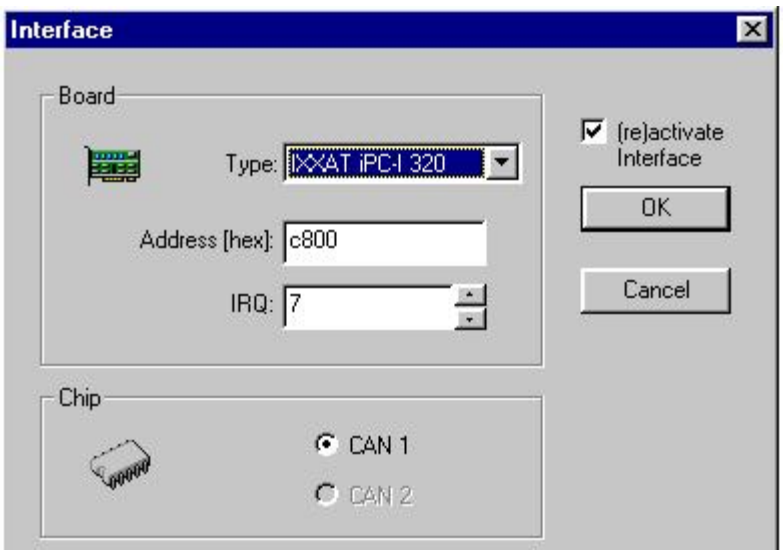
A special CAN-Bus terminator can be ordered which runs up the module in its original state, without any configuration. This makes it easily possible to reconfigure the module if it ever becomes impossible otherwise.

2.5.3 CANSAS analog connections

The CANSAS-module's measurement input connections consist of two sockets for two separate sets of measurements. Depending on the module type, either four or six differential channels can be connected. For ease of connecting, special imc plugs having screw terminals can be ordered. The pin configuration and measurement process are described in the appendix.

2.5.4 Checking connections

A dialog called from the menu item in the CANSAS interface's ‘EXTRAS’ menu lets you make settings for the CAN-Bus access and for interface parameters. Details are available in Chapter "Operation" - *Extras/ Interface* 92 and in the booklet or diskette about the interface-card.



The integration assistant can integrate and configure both available and not yet available modules.

Details are available in Chapter "Operation" - *Module/ Integrate* 81.

2.6 Integrating the CANSAS software with imcDevices

As of Version 1.4R5, the CANSAS software can operate not only as an independent program, but also integrated with the imcDevices software. This is supported by imcDevices as of Version 2.6.

If the CANSAS software has been installed, its user's interface can be called directly from imcDevices via a menu command, provided that a field bus interface of type CAN2 is part of the hardware setup.

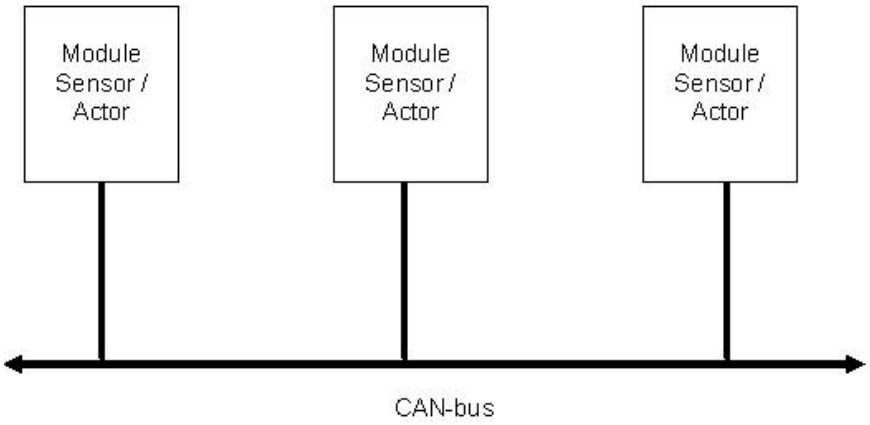
However, certain functions and menu items aren't available for calling from imcDevices. For example, the CANSAS configuration is not administered as an MDB-database, since it is saved along with the experiment under imcDevices. XML-export/import is possible. Access to the CANSAS hardware is provided via the imcDevices hardware's CAN-Bus. This communicates via Ethernet, so that all interfaces incl. imc-USB as well as the Interface-Dialog are blocked.

2.7 CAN-Bus description

The CAN-Bus (CAN = Controller Area Network) is a serial connection of all modules, with terminators at the line's ends. CANSAS is designed to be operated on a CAN-Bus which complies with CiA® standards (CiA Draft Standard 102 Version 2.0, CAN Physical Layer for Industrial Applications).

Multiple sensors and devices are connected onto the CAN-Bus and send data (at a fixed rate) via the bus. Each device (or sensor) transmits its data to the bus together with an identifier. The identifier provides an unambiguous indication of the source and sense of the data. An identifier is a packet of data up to 8 Bytes in length.

Each CAN-module is referred to as a node. A node can also be a sensor, control device, or a CANSAS-module's primary connection.



2.7.1 References to standards and literature

- CIA Draft Standard 102 Version 2.0: CAN Physical Layer
- CAN Controller Area Network by Wolfhard Lawrenz, Hüthig Verlage, 1994 Heidelberg
- ISO / DIS 11898 (ISO 11519-2) for bus drivers
- ISO / OSI reference model

2.7.2 Bus-activation

- CAN Transceiver as per ISO / DIS 11898
- galvanic isolation
- Baud rate set using software
- Standard-Identifier for CAN-Bus: 11Bit Identifier (0..2047) or 29Bit extended Identifier.

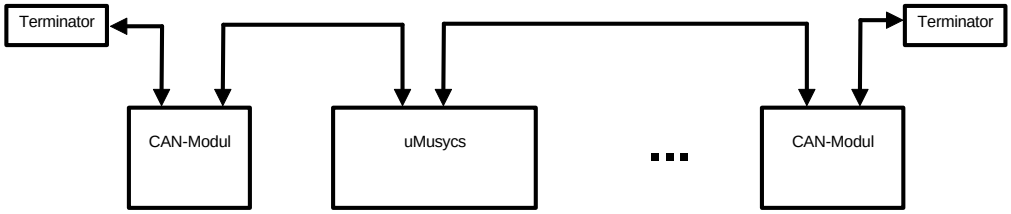
2.7.3 CAN-Bus-wiring

Connecting CANSAS without a tee-junction: Recommended

In this case the module has 2 sockets; an input and an output as per CiA®:

One 9-pin, male D-Sub socket and one 9-pin, female D-Sub socket or two 10-pin LEMO.1B.310 sockets at SL modules.

This is the preferable alternative for connecting, and this is the only alternative CANSAS is designed for. In this case it doesn't matter whether other sensors are connected with the CAN-Bus with or without tee-junctions. The illustration shows an example of several CANSAS-modules and an imc µ-MUSYCS all connected via CAN-Bus.



CANSAS connected without tee-junction

Connecting CANSAS with a tee-junction: Not recommended

If a module has only one terminal socket, then this one socket is 9-pin female. In this case, an external tee-junction must be used.

Note that with a CAN-Bus data transfer rate of 1Mbit/s, the tee-junction stub line may only be max. 30cm long. Therefore, if an external tee-junction is connected, plug the junction directly into the module socket.

2.7.4 Connecting the terminators

The terminators' resistance is 124Ω as per CiA®.

Connect terminators between Pins 2 and 7, if applicable.

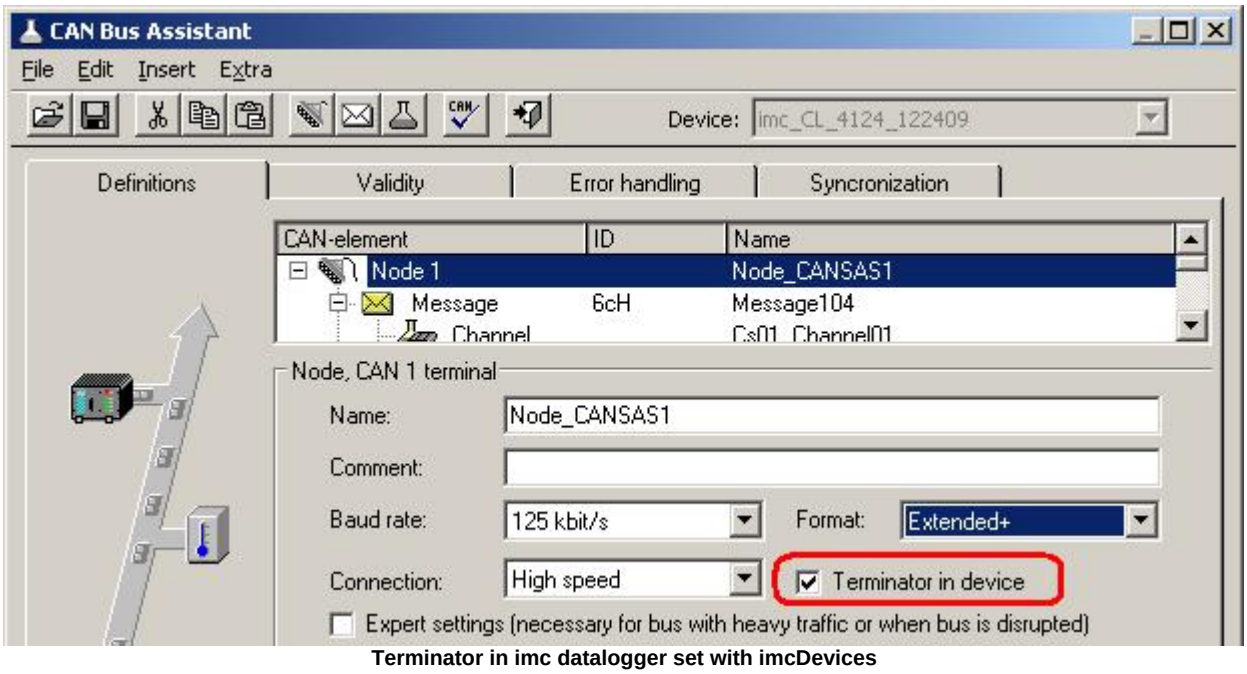
Terminators are connected at both ends of the bus. There is no other place in the line where they may be connected. The bus must end at terminators.

Safety note!

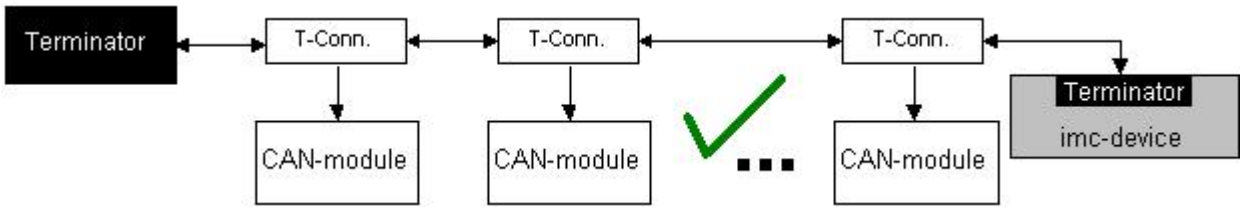
In general, it is OK to pull the CAN-plug during operation. When it is re-plugged afterwards, reset of the CANSAS-module's CAN-controllers will automatically be carried out, and then it will resume working with the CAN-Bus. However, the device is not designed to allow operation under these circumstances; it normally functions acceptably, but this cannot be guaranteed. For example, re-connecting can lead to an electrostatic discharge where voltages higher than permitted can develop and cause fatal damage to the circuitry. A person can receive a charge of 1000 V from an electric discharge; much higher than specified in ISO 11898. To ensure proper functioning, it is best to switch CANSAS off and then on again.

2.7.4.1 Termination in data logger

Current imc devices equipped with CAN-bus interface CAN2 can have a terminator resistor switched on internally via software. If the device is connected at one end of the CAN line, an external Y-cable with terminator is not needed. The terminator is activated as follows in the imcDevices software's CAN-Assistant:

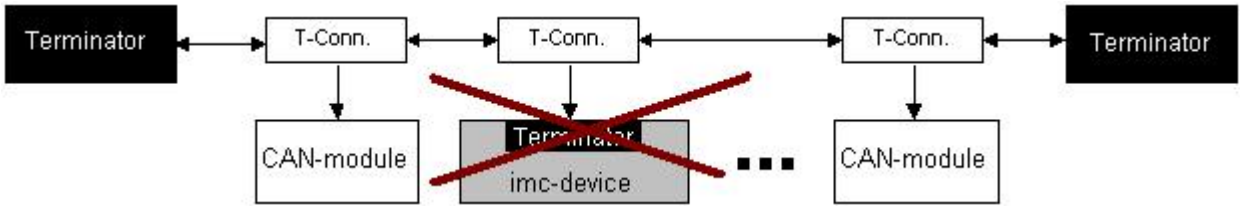


Terminator in imc datalogger set with imcDevices



Note

If the CAN-bus is already terminated correctly, that option cannot be used!



2.7.4.2 Termination with µ-CANSAS

Note that there are µ-CANSAS 355 modules both with and without internal termination. The termination is already determined at the purchase order, and cannot be modified subsequently.

Terminated µ-CANSAS modules are distinguished by a "T":

Code	Name	Order code
1160030	µ-CANSAS-T1-AS**T**	µ-CAN/µ-T1-AST
1160031	µ-CANSAS-V1-AS**T**	µ-CAN/µ-V1-AST
1160032	µ-CANSAS-B1-AS**T**	µ-CAN/µ-B1-AST

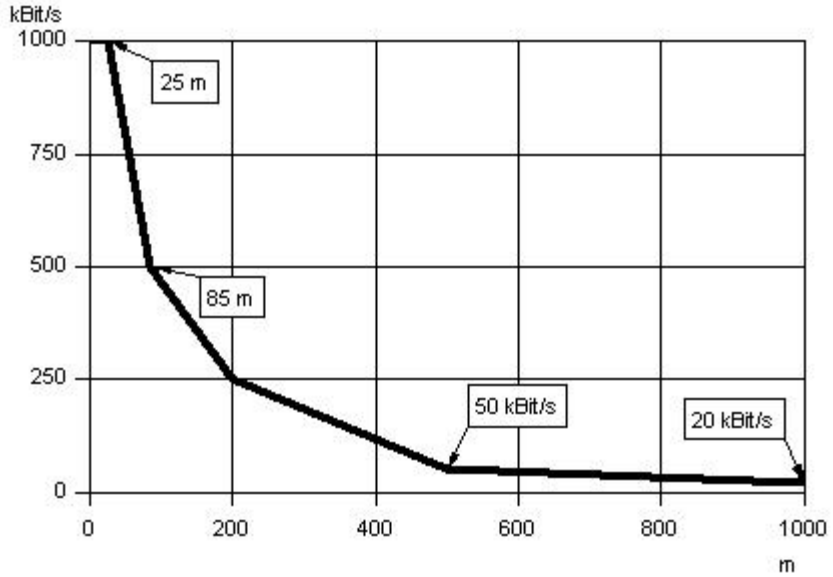
See further below for notes on wiring 44.

2.7.5 Reset-plug

To set a CAN module to its shipping condition you need a reset plug. That 9-pin standard DSUB plug must be jumpered between Pins 3 and 4.

2.7.6 CAN data transfer rate

As signal lead lines become longer, the maximum reliable data transfer rate decreases. Furthermore, the possible data rate depends on the bus timing, which in turn is determined by the hardware configuration and software version.



Data rate over line length for CANSAS-modulse or imc-USB Interface

The diagram shows the transfer rate for present-day CANSAS- modules and the imc USB Interface

Line length [m]	Data rate [kBit/s]
25	1000
85	500
200	250
500	50
1000	20

Note

Devices from imc are built with electrical isolation from the bus. Devices without electrical isolation achieve somewhat higher values for the maximum line length: 40m at 1000kBit/s or 100m at 500kBit/s.

Net data rate

Conversely, the net data rate depends on the package size and on whether the Standard Frame or the Extended Frame is used. For instance, if each CANSAS message has been optimally packed in 8byte chunks, the Standard Frame is used and there are no further subscribers connected to the node, the rate reaches 576,6 kBit/s, amounting to 36kSamples/s. The table shows the net data rates for 1 MBit/s.

Data length	Net data rate with		Data length	Net data rate with	
	Standard Frame	Extended Frame		Standard Frame	Extended Frame
0	-	-	5	360,4 kBit/s	305,3 kBit/s
1	72,1 kBit/s	61,1 kBit/s	6	432,4 kBit/s	366,4 kBit/s
2	144,1 kBit/s	122,1 kBit/s	7	504,5 kBit/s	427,5 kBit/s
3	216,2 kBit/s	183,2 kBit/s	8	576,6 kBit/s	488,5 kBit/s
4	288,3 kBit/s	244,3 kBit/s			

2.7.7 Number of CAN-nodes

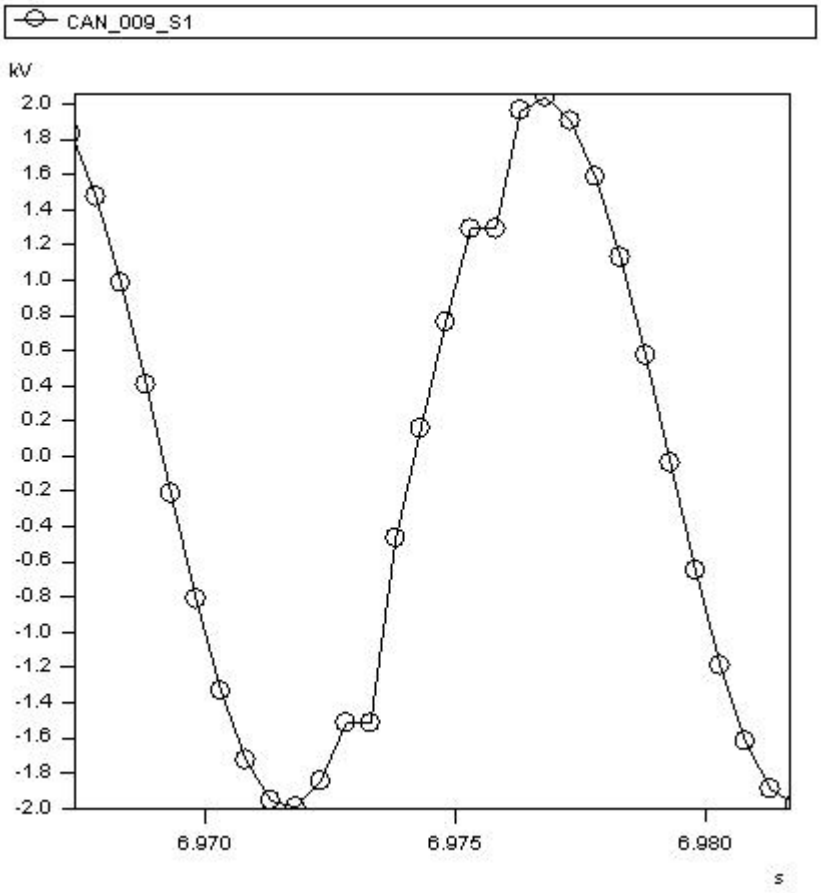
	Number of nodes		
Line length	**32**	**64**	**100**
100 m	0,25 mm²	0,25 mm²	0,25 mm²
250 m	0,34 mm²	0,5 mm²	0,5 mm²
500 m	0,75 mm²	0,75 mm²	1,0 mm²

Note

The cross section of the line should increase in size as more CAN-nodes are served by the system.

2.7.8 Duplicate samples in during data capture

Due to factors affecting the overall system, CAN-Bus modules feature a considerable amount of jitter (<100µs) in outputting the measured data. If the data are recorded at a high sampling rate, some values may be duplicated or, in rarer cases, erroneous data may appear. This effect only concerns modules having a high sampling rate (e.g. µ-CANSAS, UNI8)



Possible remedies:

a) **Universal**:
Sample the CANSAS channel with a time stamp instead of equidistantly.

b) **When using imcDevices or imcStudio**:
Use the CAN-1 synchronization 112. This is absolutely necessary if subsequent data processing is performed with in Online-FAMOS.

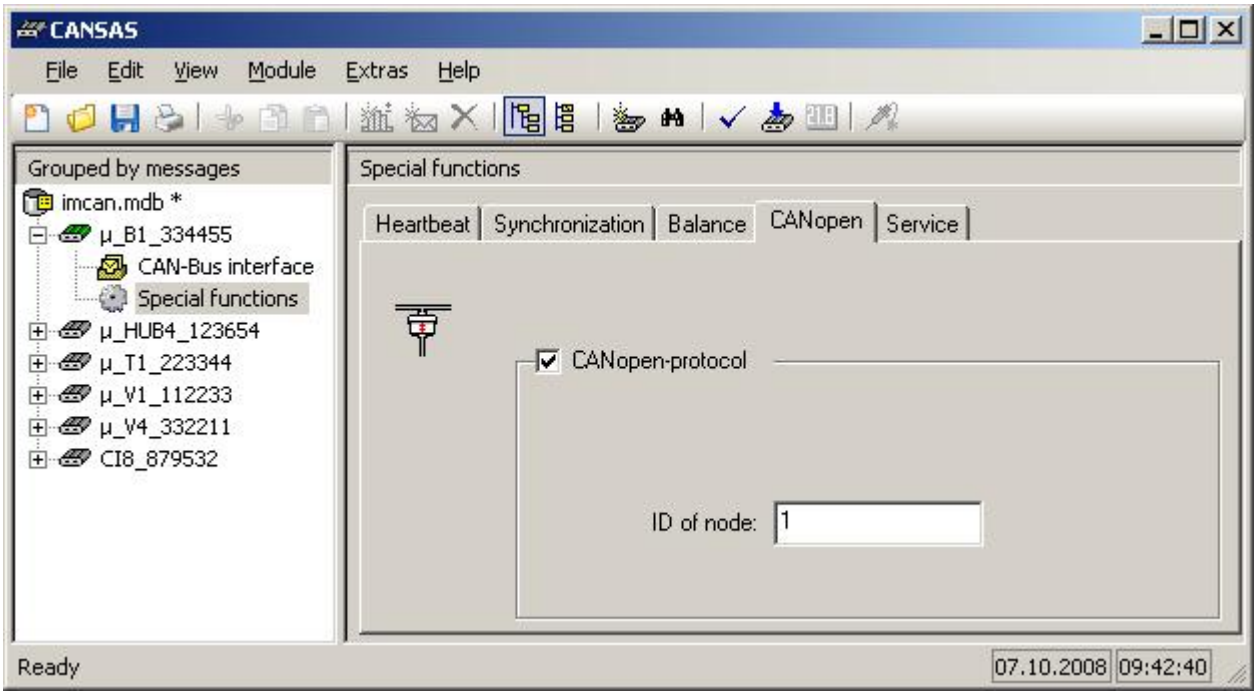
2.7.9 CANopen

CANopen® is a standardized protocol based on CAN with a 7-layer protocol stack for a variety of hardware and software. Its open structure allows automated configuration of a CAN-network of up to 111 nodes and up to 127 logical devices per node. At present this protocol is used in a every possible field. While it once was used primarily for drive-controlled machines, it is now found in off-road vehicles, medical equipment and even building automation.

By means of standardized communication objects for real-time data and configuration data, as well as additional communication objects, developers can avoid performing time-consuming implementation and specification work for the CAN-Bus. Uniform access to all device parameters is thus made possible.

Some CANSAS modules are configured upon purchase as CANopen® devices. They support the CANopen® protocol in accordance with "CiA DS 301 V4.0.2" and "CiA DS 404V1.2"; 4 PDOs in INT16, INT32, and FLOAT.

A CANSAS module can be set either as a Standard CAN-Bus or CANopen® module under the heading "Special functions" on the "CANopen" page. If it is set as a CANopen® module, then the node-ID can be entered in this window. In this case, the CANSAS module's entry in the tree diagram has only the two branches "Bus Interface" and "Special functions", along with their respective settings parameters. No other parameters can be set by means of CANSAS.



If "Readable configuration 98 = ON" is set, the CANopen® settings are saved in the module, so that they are available upon the respective module being integrated into the system.

Detailed descriptions of each module type are available in the separate CANopen® documentation. This can be found along with the module's ESD file on the CANSAS Installation CD.

Modules supporting CANopen® can be found here 215.

2.7.9.1 Limitations

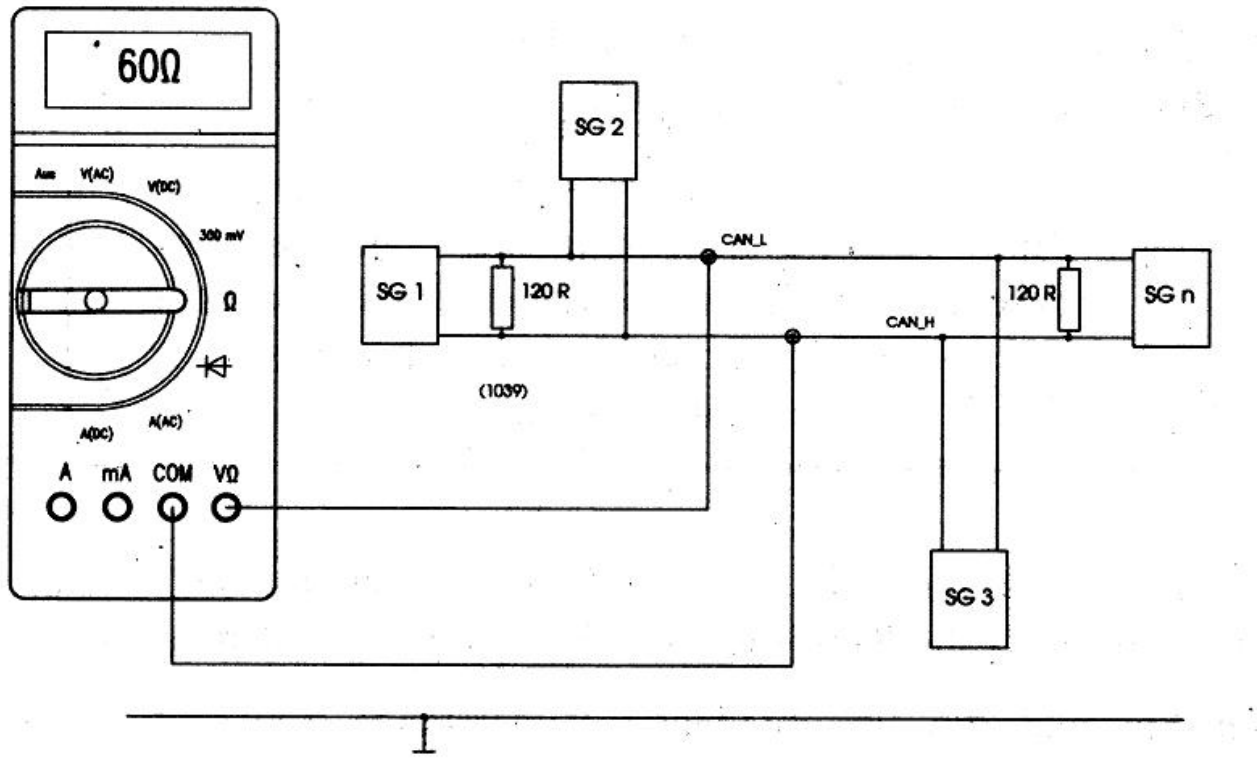
CANSAS modules with CANOpen® suffer certain limitations, since CANOpen® protocol does not include some functions:

- The CANSAS module is not able to generate virtual channels
- No control over LEDs

2.7.10 Troubleshooting tips for disturbances of the CAN-Bus

Disturbances of CAN-Bus transmission can be due to a variety of causes, from long signal lines to lines which are short-circuited. This section will introduce some simple procedures for checking the CAN-Bus, which may be able to detect any errors in the CAN-Bus wiring.

Simple inspection of the line termination

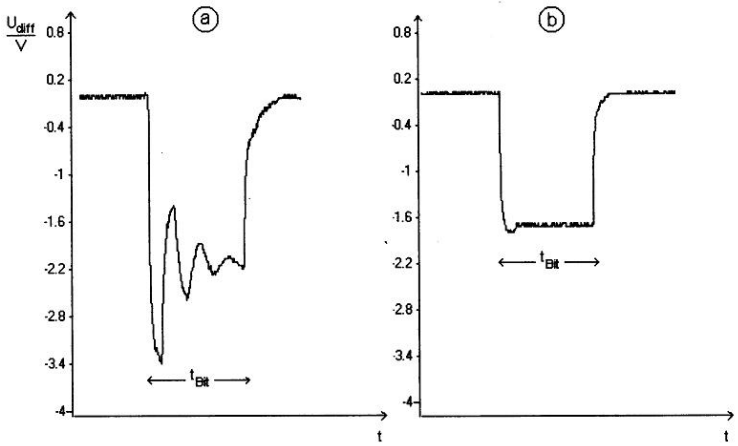


As an example, in order to be able to perform measurements using the CAN-Bus on board a vehicle, you must obtain access to the potential divider.

To test the CAN-Bus resistors between CAN-Low and CAN-High, the resistance measurement should generally be carried out so that the object under test must not be under current during the measurement.

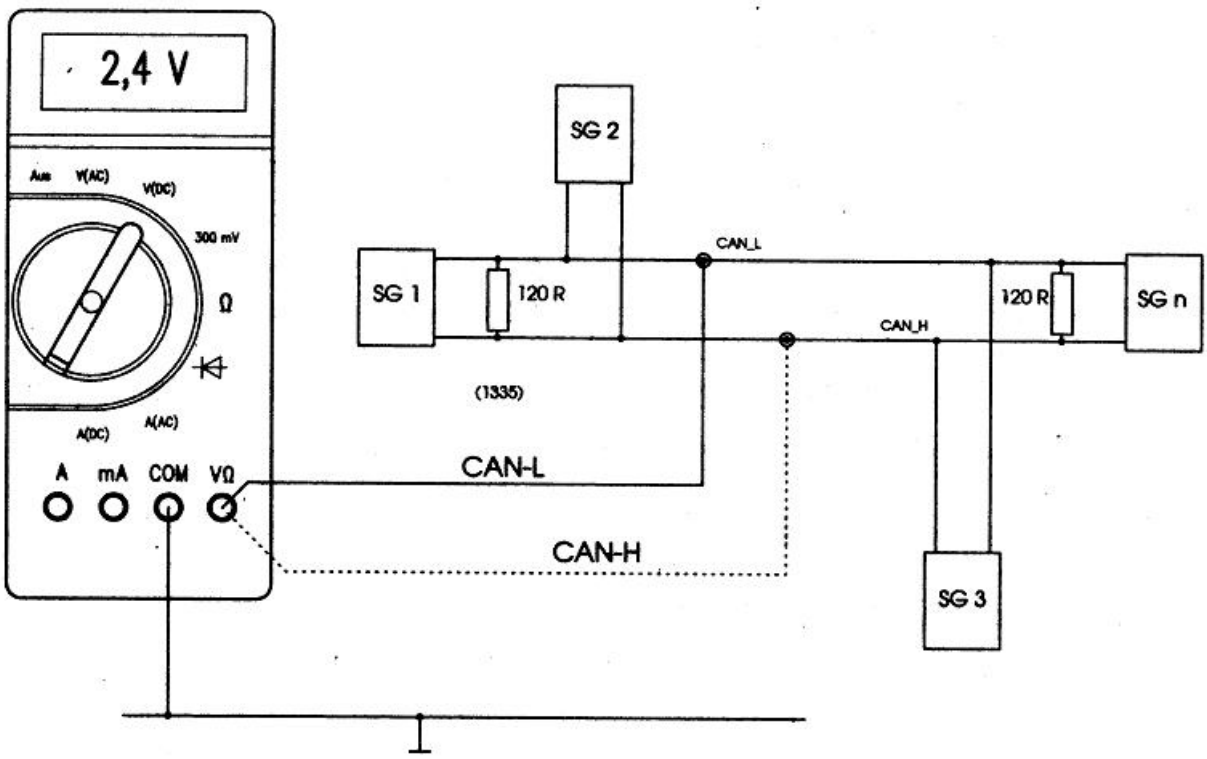
The two termination resistors are connected in parallel and together form an equivalent resistance of 60 Ohms.

Bus Reflections



Reflections at line branches can be minimized by keeping the branches as short as possible. By terminating lines at either end, the best possible combination of transfer rate and bus line length can be achieved.

DC-voltage measurement with high-speed CAN-Bus



A good multimeter can usually measure the recessive CAN-Bus level, measured to ground.

The two CAN-Bus levels are approximately equal.

For the CAN-Bus levels CAN-H and CAN-L, each measured to ground, the following approximations apply:

For CAN-H recessive approx. 2,4 Volt.

For CAN-L recessive approx. 2,6 Volt

DC-voltage measurement with low-speed CAN-Bus

In contrast to high-speed bus coupling, the low speed bus coupling can also be run in single-wire mode.

Practical notes on measuring:

- The DC-voltages apply with an operating voltage of 12 V.
- These voltages are guideline values and can deviate by a few multiples of 100 mV.
- No additional measurement instruments such as an oscilloscope, etc., may be used at the same time.

1. Possibility – the CAN-Bus is working correctly

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	OK	OK	3,3 V	1,8 V	1,5 V
Sleep-mode	OK	OK	4,9 V	0,1 V	4,8 V

2. Possibility - CAN_H or CAN_L not connected properly

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	not connected	OK	4,8 V	1,7 V	3,1 V
Sleep-mode	not connected	OK	4,9 V	0,1 V	4,8 V
Active	OK	not connected	3,3 V	0,2 V	3,1 V
Sleep-mode	OK	not connected	4,9 V	0,1 V	4,8 V

3. Possibility – short circuit between CAN_H or CAN_L and GND

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	at GND	OK	4,8 V	0,1 V	4,8 V
Sleep-mode	at GND	OK	4,9 V	0 V	4,9 V
Active	OK	at GND	0,01 V	0,2 V	-0,2 V
Sleep-mode	OK	at GND	0 V	0,1 V	-0,1 V

4. Possibility – short circuit between CAN_H or CAN_L and SUPPLY

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	at SUPPLY	OK	4,8 V	12 V	-7,2 V
Sleep-mode	at SUPPLY	OK	5,4 V	12 V	-6,6 V
Active	OK	at SUPPLY	12 V	0,2 V	11,8 V
Sleep-mode	OK	at SUPPLY	12 V	0,1 V	11,9 V

5. Possibility - CAN_H and CAN_L are connected

Bus	CAN_H	CAN_L	CAN_L - GND	CAN_H - GND	CAN_L - CAN_H
Active	at CAN_L	at CAN_H	2,9 V	2,9 V	0 V
Sleep-mode	at CAN_L	at CAN_H	2,5 V	2,5 V	0 V

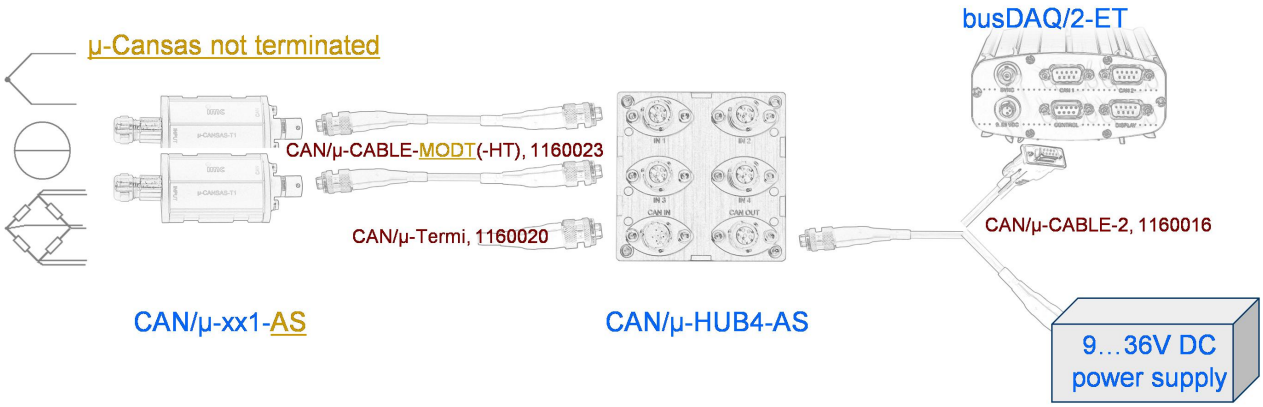
2.7.11 Cabling of µ-CANSAS

In conjunction with a busDAQ unit able to supply the power for the connected µ-CANSAS 355 units, a variety of system configurations are possible. When selecting a configuration, be sure to also select appropriate cable terminations.

2.7.11.1 Power from external power supply unit

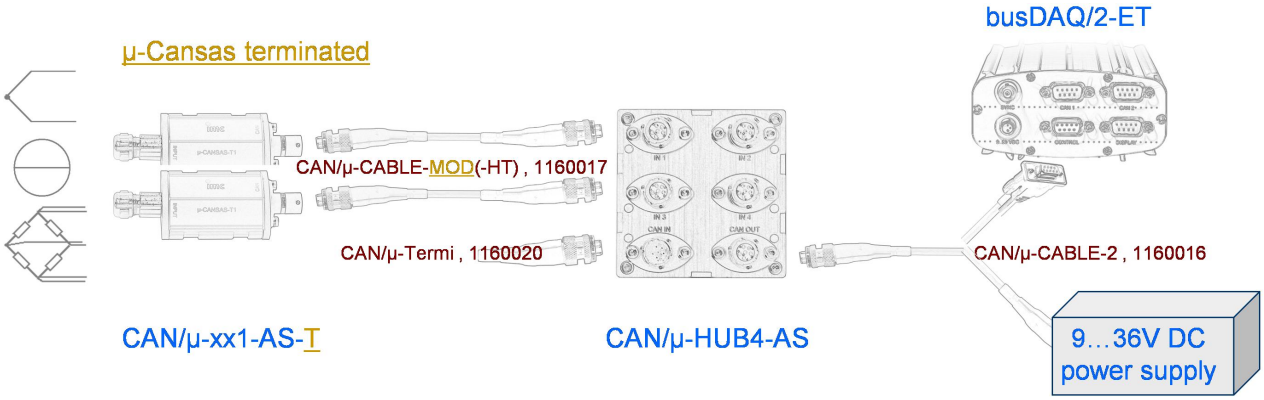
Configuration 1a with unterminated, single-channel CANSAS

Termination located inside of the cable



µ-CANSAS terminated inside of the connection cable, power supplied via external power unit

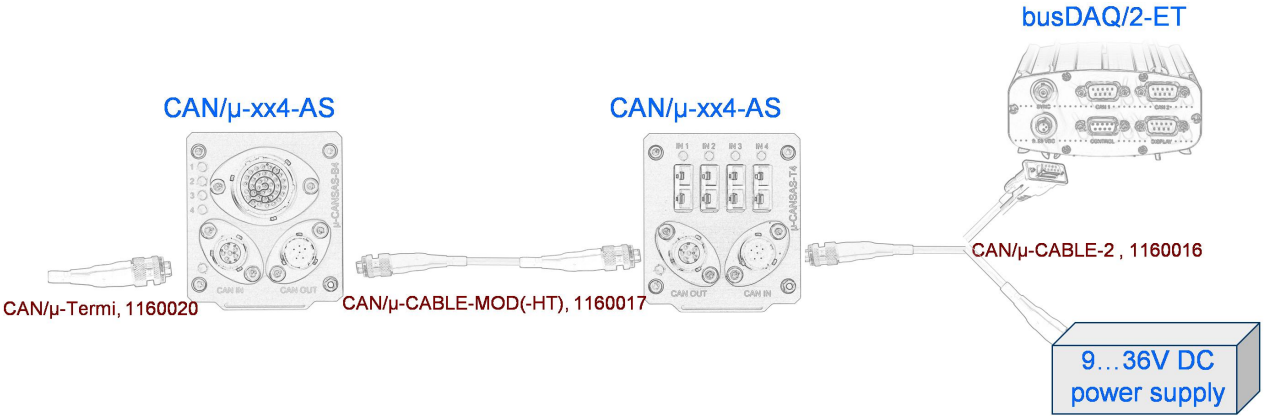
Configuration 1b with internally terminated, single-channel µ-CANSAS



µ-CANSAS terminated internally. Supply via external power supply unit

Configuration 2: two four-channel µ-CANSAS units connected to the busDAQ

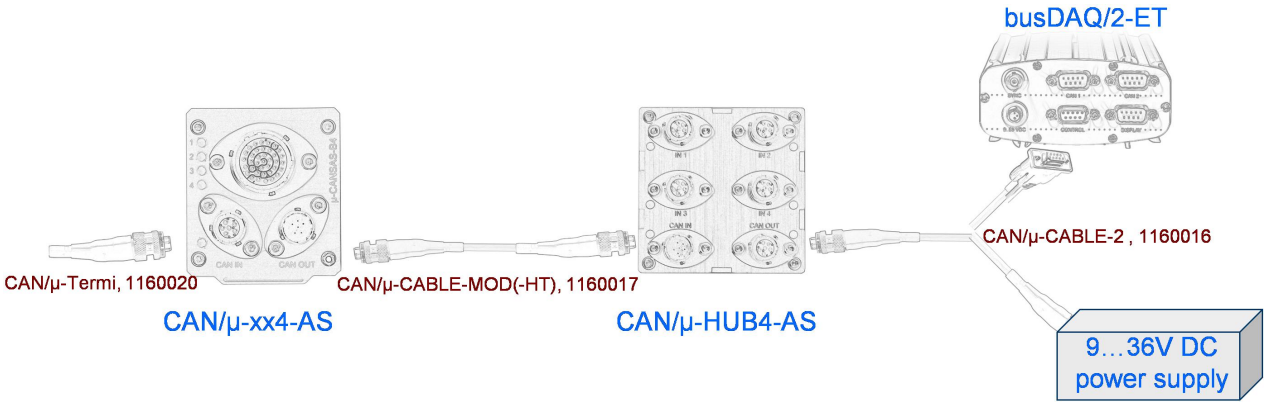
Termination provided by Termi-connectors, and internally at the busDAQ



Termination at the last 4-channel µ-CANSAS unit. Power supply from the power supply unit

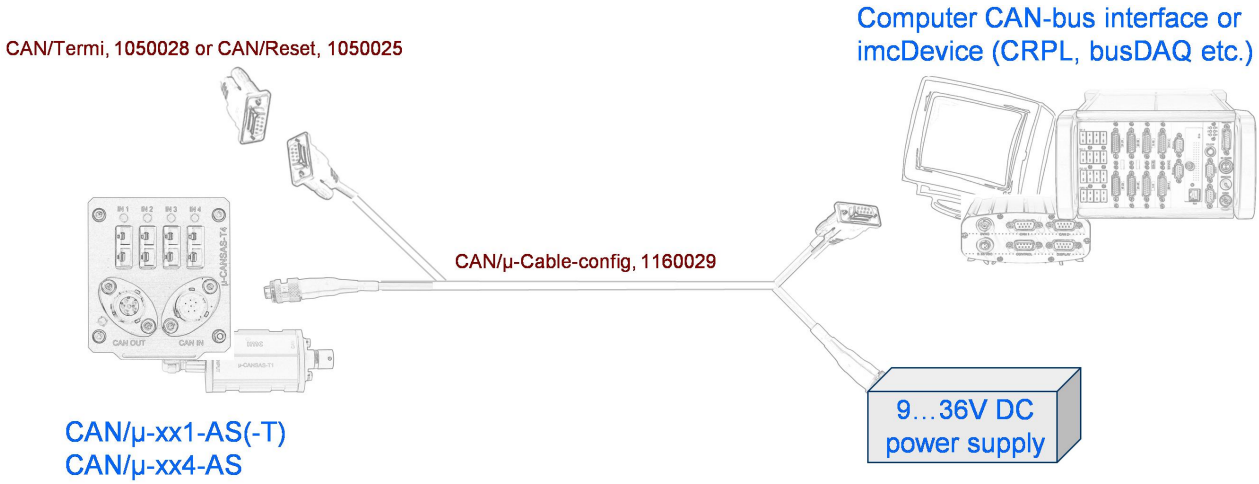
Configuration 3: 4-channel µ-CANSAS unit via HUB

Termination provided via Termi connector and internally at the busDAQ



Termination at the last 4-channel µ-CANSAS unit. Power supplied from the power supply unit

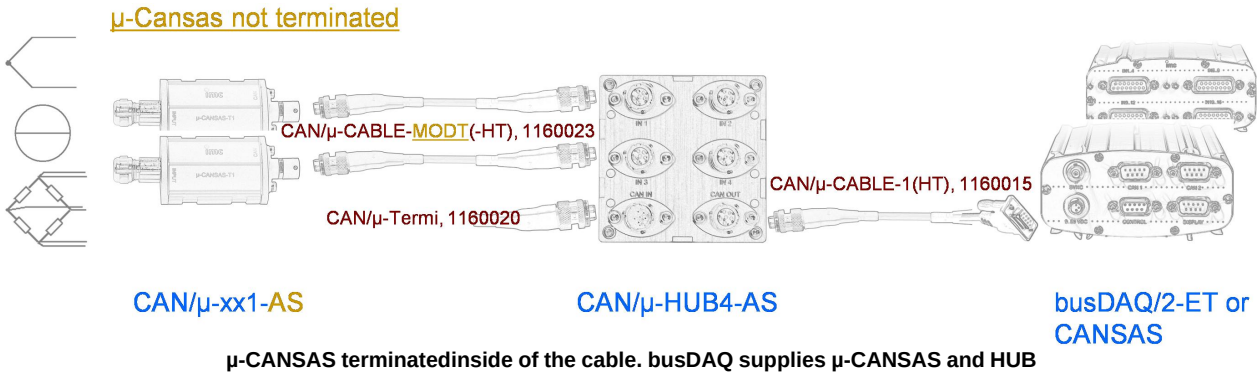
Configuration 4: Integrating a µ-CANSAS in a standard CAN-Bus system



Termination with Y-cable and µ-CANSAS. Supply via power supply unit

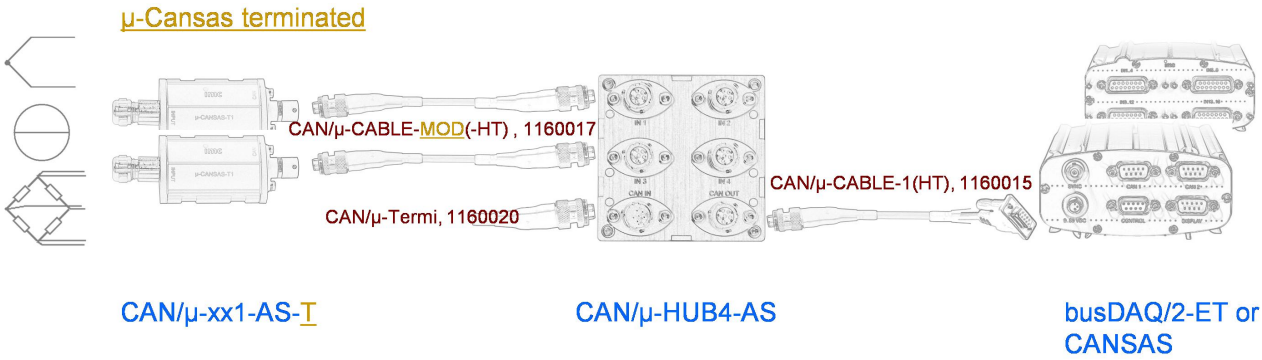
2.7.11.2 Power supply from busDAQ unit

Configuration 5: µ-CANSAS via HUB. Termination inside of the cable



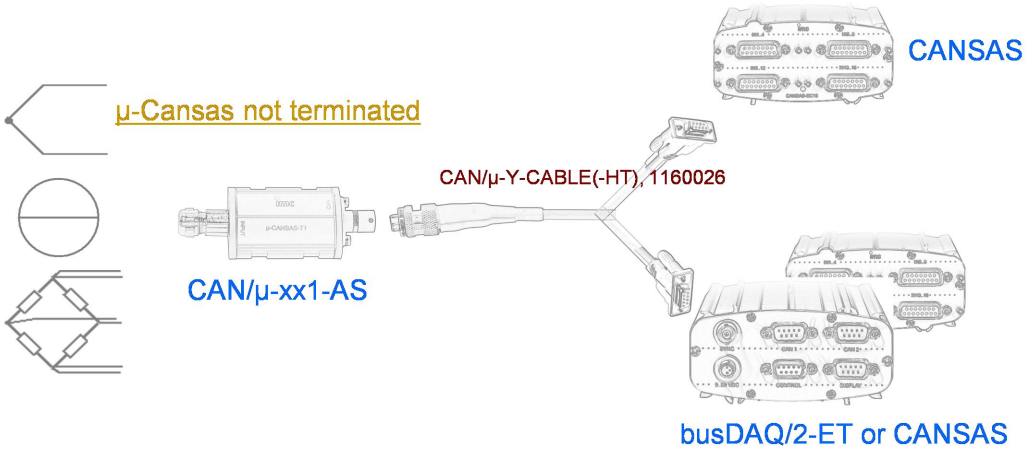
µ-CANSAS terminatedinside of the cable. busDAQ supplies µ-CANSAS and HUB

Configuration 6: µ-CANSAS via HUB. Termination inside of the cable



µ-CANSAS are terminated internally. busDAQ supplies µ-CANSAS and CANSAS

Configuration 7: µ-CANSAS and CANSAS. Termination inside of the busDAQ unit and at the CANSAS



µ-CANSAS units are not termated. busDAQ supplies µ-CANSAS and CANSAS with power

Operation

3.1 Calling the program

Once the CANSAS application has been successfully installed, it can be called from the Windows Start menu.

You can use the Start menu's 'Run'-command to start the application. To do this, find the file

imcansas.exe.

CANSAS enters various settings into the Windows System Registry. In the English program version, the main key is designated

`HKEY_CURRENT_USER\SOFTWARE\imc Measurement and Control\Default\CANSAS`

If you wish to work with personally customized settings, then call the file imcansas.exe using the calling parameter **/cMySettings**. In this case, the main key is designated

`HKEY_CURRENT_USER\SOFTWARE\imc Measurement and Control\MySettings\CANSAS`

Create a shortcut to imcansas.exe. In the menu for setting shortcut properties, supplement the call command by appending the parameter /c(name).

Calling CANSAS from imcDevices

As of Version 1.4R5, the CANSAS software can operate not only as an independent program, but also some of its elements are integrated with the imcDevices software. This is supported by imcDevices as of Version 2.6.

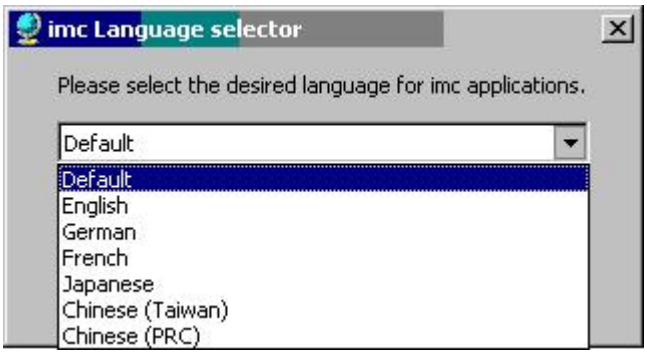
However, certain functions and menu items aren't available for calling from imcDevices. For example, the CANSAS configuration is not administered as an MDB-database, since it is saved along with the experiment under imcDevices. XML-export/import is possible. Access to the CANSAS hardware is provided via the imcDevices hardware's CAN-Bus. This communicates via Ethernet, so that all interfaces incl. imc-USB as well as the Interface-Dialog are blocked.

3.1.1 Language setting - imcLanguageSelector

The software is provided with different languages, which can be selected with the program *ImcLanguageSelector*.
Thus installing several language versions of the software is not necessary. As default the language of the operation system will be used. In case of the imc product is not provided with the language of the WINDOWS version, English will be used.

The *ImcLanguageSelector* is locaed at *C:\Program files\Imc\Shared.*

imc Language selector
Please select the desired language for imc applications.
Default
Please note, that the setting above may not be realizable by every imc application.
OK
Cancel
Apply



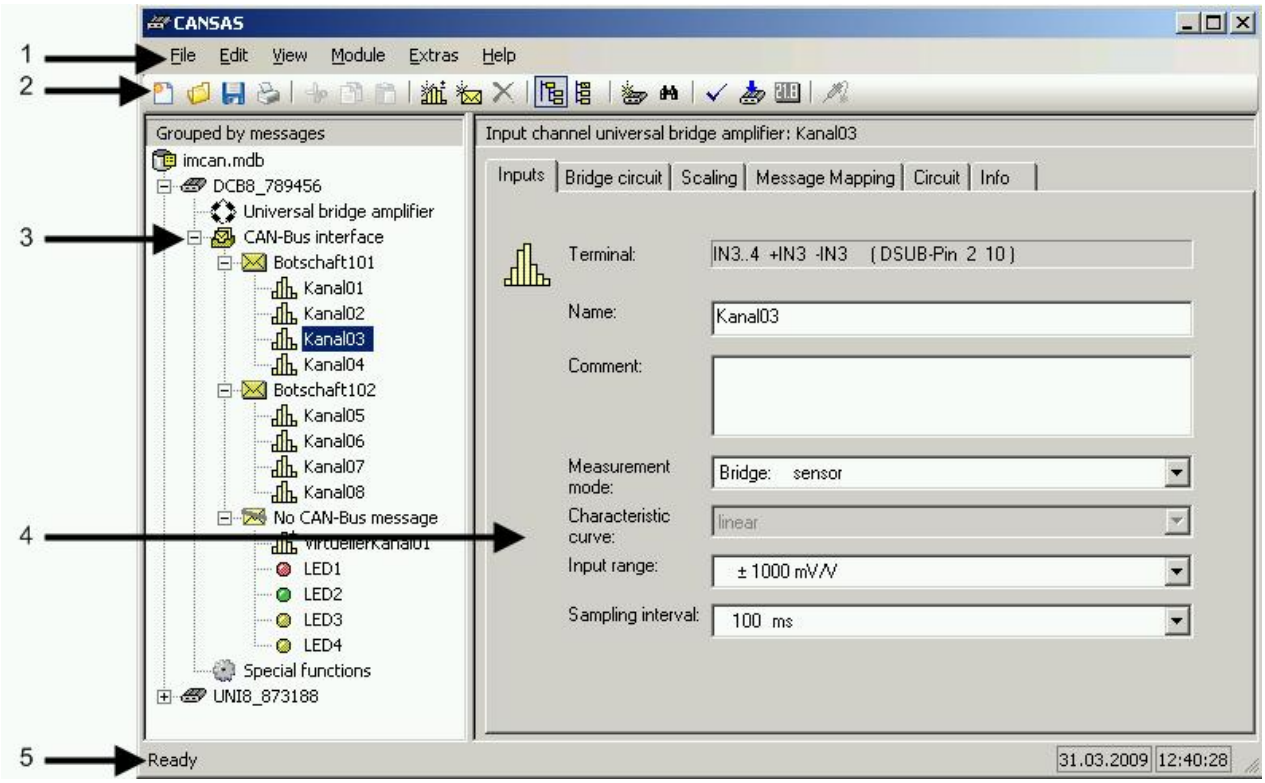
3.2 The user interface

3.2.1 Introduction

Starting and configuring the CANSAS module is accomplished using the CANSAS parameterizing software. This application works by means of a module database. All CANSAS module settings are saved in this database. CANSAS' application window always appears as it was left at the end of the last session.

Upon starting, a welcoming screen pattern, which displays statements about the program version, appears.

The contents of the most recent module database are read in and the application window is set up in the manner shown below:



The application window features the following elements:

- Menu bar [1]
- Toolbar [2]
- Module directory tree [3]
- Properties dialog [4]
- Status bar [5]

3.2.1.1 "File"- menu

This menu offers functions for working with the database and for printing.

The menu's commands are as follows:

Command	Action
New	Creates a new database
Open...	Opens an existing database
Save	Saves all changes made to the current database
Save as...	Saves all settings in a different, user-specified database
Export...	Exports module settings in the project database format of the company Vector Informatik GmbH or in imc's µMUSYCS CAN-Assistant format or as an XML-file.
Import…	Import module configuration from a XML-file.
Print...	Prints out the module settings
Print Preview	Displays a preview of the printout on the screen
Print Setup...	For selecting a printer and a printer connection
Exit	Closes CANSAS

3.2.1.2 "Edit"- menu

The menu's commands are as follows:

Command	Action
Undo	Cancels the effect of the last editing function performed
Cut	Removes data from the document into the Clipboard
Copy	Copies data into the Clipboard from the document. Copies a module configuration, if a module is selected.
Paste	Inserts data into the document from the Clipboard
New Message	Adds a new message to the module configuration
New Virtual channel	Adds a new virtual channel to the module configuration
Rename	Renames a module, message or channel
Delete	Deletes a module, a CAN-message or a virtual channel
Start imc-sensors	Starts imc - sensors database
Paste sensor...	Paste selected sensor from imc – sensor into selected channels, to set parameters.

3.2.1.3 "View"- menu

The menu's commands are as follows:

Command	Action
Toolbar	Toggles toolbar ON/OFF
Status bar	Toggles status bar ON/OFF
Split	Splits the active window into two segments
Adjust	Adjusts the window size to make all entries on the right side visible
Grouped by messages channels	 Groups the entries in the tree by message Groups the entries in the tree by channel
Expand modules	Expand all branches of selected modules
Expand all branches	Expand all branches of all modules, without regard of selection
Collapse all branches	Collapse all branches of all modules

3.2.1.4 "Module"- menu

The menu's commands are as follows:

Command	Action
Integrating-Assistant…	Integrates one or more CANSAS modules into the database
Find selections...	Finds selected CAN-Bus-connected CANSAS modules
Find me...	Let the selected module red blinking for 5s
Check configuration…	Verifies the configuration
Configure…	Configures CANSAS modules
Configure + Shift	Configures CANSAS modules even if configuration has not been changed.
Measure	Conducts a measurement using the CANSAS modules
Sensors: Prepare plug-in… Read identifying data..	 Set the module to default values. Afterwards sensors can be connected. Read the information from the EPROMS connected to the sensors.

3.2.1.5 "Extra"- menu

The menu's commands are as follows:

Command	Action
Interface…	Adjusting the PC / CAN-Bus interface
Options…	Dialog to set global options

3.2.1.6 "?"- menu (Help)

The menu's commands are as follows:

Command	Action
About CANSAS...	Shows the application version number

3.2.1.7 Control Menu

The Control menu is located on the title bar and comprises the following commands:

Command	Action
Restore	Restores the size and position of a window to its state before the command Maximize or Minimize was implemented.
Move	Once the arrow pointer appears, the window position can be shifted by using the arrow buttons. Note: the command is not available if the window is already in Maximize-mode.
Size	Once the arrow pointer appears, the window size can be altered by using the arrow buttons. Note: the command is not available if the window is already in Maximize-mode.
Minimize	Reduces the active window to an icon.
Maximize	Makes the active window fill the screen.
Close	Closes the window.

3.2.2 Toolbar

The toolbar extends horizontally near the top of the window, below the title bar. It offers quick access to many CANSAS tools via a mouse-click. If the mouse cursor is held for a short while over a screen button, a brief help text will appear as a 'tool tip'.

To toggle the toolbar on and off, you can use the item 'Toolbar' in the 'view'-menu, or (ALT, A, S).

Button	Action
	Creates a new database.
	Opens an existing database. The 'Open database' dialog appears, which allows you to select the desired file for opening.
	Saves all changes to the database.
	Prints out the module settings.
	Removes the highlighted data to the Clipboard.
	Copies the highlighted data to the Clipboard.
	Inserts the contents of the Clipboard to the designated position
	Adds a new virtual channel to the module
	Adds a new CAN-message to the module
	Deletes a module, a CAN-message or a virtual channel
	Checks the current configuration for errors
	Integrates an additional CANSAS module into system
	Configures the CANSAS module
	Takes a measurement using the CANSAS modules
	Finds all CANSAS modules connected to the CAN-Bus
	Groups the entries in the tree by message
	Groups the entries in the tree by channel
	Adjusts the window size to make all entries on the right side visible
	Shows the application version number

3.2.3 The Module Tree

The Module Tree represents the contents of the currently open database in a tree structure. The structure's branching serves to indicate the group membership relationships among the entries. Entries located on the same level are of equal rank. All entries of a particular type (e.g. input channels) are denoted by the same pictogram symbol.

The topmost entry (root) represents the module database. In this, multiple CANSAS modules are stored. Once the database icon is opened, the modules are displayed on the first hierarchy level. Opening a CANSAS module's symbol shows its 3 important components: CAN-Bus interface, input or output stage and the group of virtual channels. All previously defined CAN-Bus messages are located under the **CAN-Bus Interface** branch. Above this branch is the branch representing the input or output type, which depends on which module is involved. The branches of the individual channels appear under the CAN-Bus message branches. The **Virtual Channels** branch comprises all defined virtual channels and special channels such as LED's which shine in response to particular processing results. This manner of structuring the tree representation takes into account the logical relationships within the module, and this representational option is selected as the item **Grouped by channel** in the **View** menu.

A second manner of representation is called **Grouped by Message**. It gives more weight to the CAN-Bus and its messages. Up until the second hierarchy level, the appearance of the two different tree structures is the same. Once the CANSAS module's icon is opened, the entry for the input/output type and the CAN-Bus-Interface branch appear. The message definitions can be seen under the CAN-Bus-Interface branch. Opening the message's icons reveals which channel or virtual channels are associated with which message. Parallel to the message branch, there is a branch called **Without CAN-Bus Message**. This branch comprises all channels which were not assigned to a message and whose signals are thus are not transmitted. Select menu item **View/Grouped by Message** to implement this representational option.

Each entry on a tree has properties such as Name, Sampling Rate, etc. These are displayed in the segment on the right.

If multiple tree entries having the same properties are simultaneously selected, then the properties are reflected in the Properties dialog. If entries of different types are simultaneously selected, then the Properties dialog will indicate that stating the properties isn't possible.

The Module Tree has the following types of entries:

Symbol	Entry type	Properties
	Module database	name, size, number of module entries
	CANSAS module CANSAS module which has supplied information	name, serial number, firmware version, hardware version
	CAN-Bus-Interface	Baud rate, message-identifier
	Differential amplifier inputs for a CANSAS-C12 or CANSAS-ISO 8 module	type, time offset correction
	Input stage of a CANSAS-BRIDGE2 module (bridge amplifier)	Button functions, duration of shunt calibration and of bridge balance
	Input stage of a CANSAS-INC4 module	Switching threshold, hysteresis, low-pass filter
	Input stage of a CANSAS-DI16I module	Input voltage range, sampling time
	Output stage of a CANSAS-DO16R module	Output configuration
	Output stage of a CANSAS-DO8R module	
	Output stage of a CANSAS-DAC8 module	
	Virtual channels	none
	CAN-message	name, identifier, message length
	Without CAN-message	none
	Input channel	name, input configuration, input range, sampling rate, scaling, message mapping
	Digital input (bit) of a DI16I module	name, comment
	Digital input port of a DI16I module	name, comment
	Digital output (bit) of a DO8R module	name, comment, functionality, message mapping
	Analog output of a DAC8 module	name, comment, functionality, message mapping

Symbol	Entry type	Properties
	Virtual channel	name, function, units, message mapping
	Virtual special channel (LED)	name, function
	Hint or error message	none
	Special functions (synchronisation, heartbeat)	

3.2.4 Properties Display

ropertie dialog for an input

In the right-hand segment of the application window, the properties of the currently selected Module Tree entry are displayed. Depending on the type the entry belongs to, the properties may appear on up to three 'index cards'. Paging through the cards is accomplished by clicking on the card tabs.

If multiple Module Tree entries are simultaneously selected, the Properties display will attempt to reflect their common properties. This will only work if the entries are of the same type, otherwise the Properties display will indicate that it's not possible.

There is a header at the top of the Properties display in which the entry type and the names of the entries are stated.

The Properties display has various dialog boxes and combo boxes as well as text boxes. The properties of the CANSAS modules or input channels can be altered by making selections or entries. The alterations are applied as soon as the card is turned on or the current selection in the tree is changed, or prior to the execution of a menu command.

If the mouse cursor is held for a short while over a text or combo box, a 'tool tip' as a brief help text will appear.

If multiple Module Tree entries having the same type are concurrently selected, then "**???**" will appear in the relevant Properties dialog boxes. This means that this property of the various entries does not have a common value. If the input box is even disabled, this means that the property cannot be common to all the entries; an example is a channel's name.

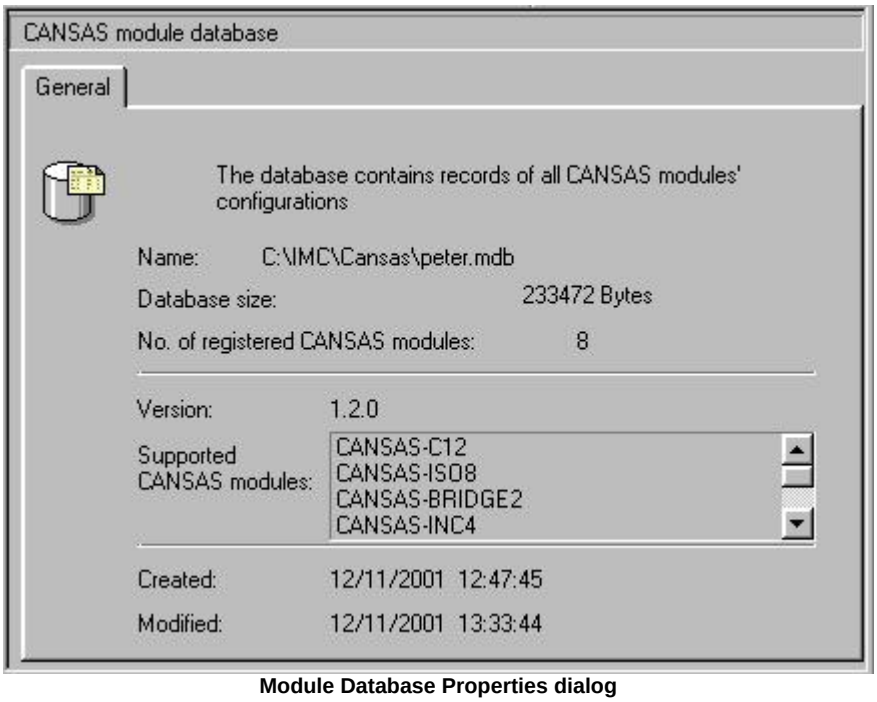
Combo boxes appear empty if the properties differ.

The size of the Properties dialog is automatically adapted when the size of the main window is changed. But it can occur that the Properties dialog cannot fit completely into the window if the window becomes very small. Use the menu command 'View/ Adjust' to optimize the window size.

3.2.4.1 Module database

The display of the Module Database is accessed from the Module Database branch of the Module Tree, the first branch on the tree.

This virtual filecard shows a readout of some of the currently open Module Database's properties, including the complete filename, file size, and number of CANSAS modules stored.



Module Database Properties dialog

In the middle portion, the database version and module types supported by CANSAS are indicated.

The lower portion of the card shows the date of creation, the date last modified and last accessed.

If the application was unable to open any module database, the statement "**unknown**" appears next to the Database-symbol in the Tree. The readout on the properties display is then empty.

3.2.4.2 CANSAS Module

The CANSAS module's properties depend on the module type. The following is a description of the properties common to all CANSAS modules.

3.2.4.2.1 General

CANSAS Module Properties dialog, Page 1

In addition to the CANSAS module ***type***, the number of input channels is indicated. In the case of a CANSAS-INC4 module, there are 4 input channels.

The ***serial number*** is assigned when the CANSAS module is manufactured, and it is unique. It is the main criterion for ordering the modules in the module database. The serial number cannot be changed. It is automatically inquired and entered into the database when the module is introduced into the system.

The ***name*** can be specified arbitrarily. It is a means of identifying the module. There are only these limitations on the possibilities for the name:

- there must be a name,
- the name may not contain certain characters. All alphanumeric characters and the characters _ ~ are allowed. The first character may not be a digit,
- the name must be unique within the database,
- the name may contain no more than 64 characters.
- Incorrect names are displayed in the status bar.

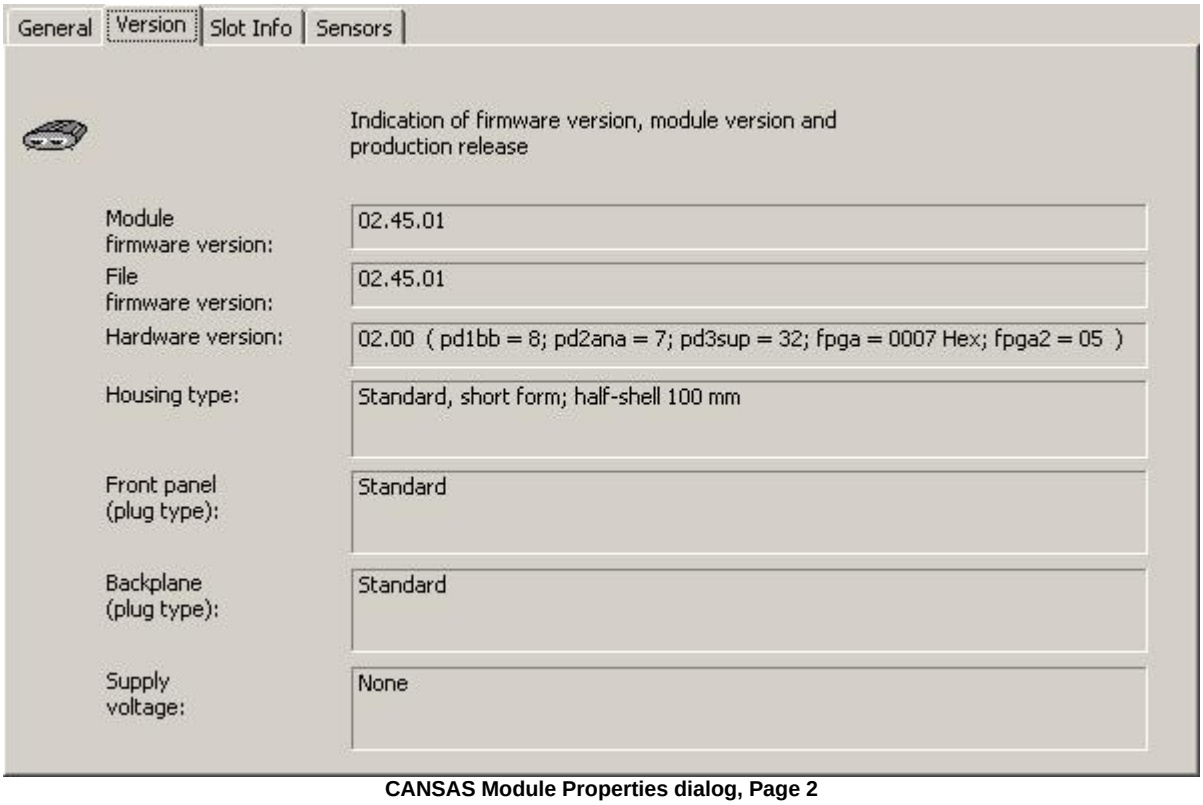
As soon as the cursor is moved off of the input box, the name is updated in the Module Tree.

The ***Comment*** box is provided for the purpose of making notes about the module.

Furthermore the following status information is displayes:

- The box 'Connection' shows whether a connection to the CANSAS module has been made (Integrate, Configuration, Measurement, Find).
- Information, if the software settings are matching to the module configuration
- Status of calibration

3.2.4.2.2 Version



CANSAS Module Properties dialog, Page 2

The second index card contains information about the firmware and hardware versions.

The module firmware version is the version currently being implemented by the CANSAS module. It can only be indicated once a connection to the module has been established.

When the software is installed, a subdirectory named \FIRMWARE is created. The various firmware files are copied to this folder. There are different firmware files to reflect the varying module types and versions. When this page is displayed, the version number is read from the firmware file and indicated under **File firmware version**.

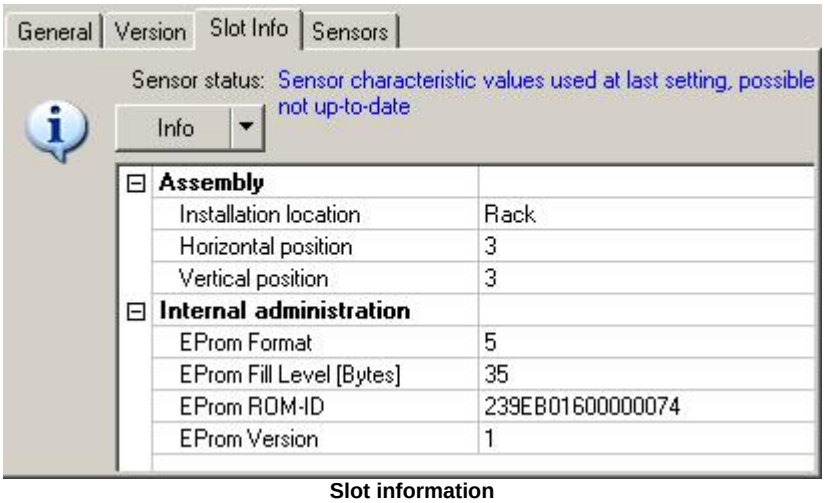
The hardware-version can only be indicated after a connection has been established.

About the version number

The version number consists of a more-significant-digit part and a less-significant-digit part. For the system to work, the higher-value part of the hardware version number must agree with that of the firmware version. The firmware can only be updated if the lower-value part of the version number is different.

3.2.4.2.3 SlotInfo

Display of slot identification. For further information see Racks slot identification 104.



Slot information

3.2.4.2.4 Sensors

Exchanging sensor information between the sensor-Eprom and sensor database. Further information see here 207.

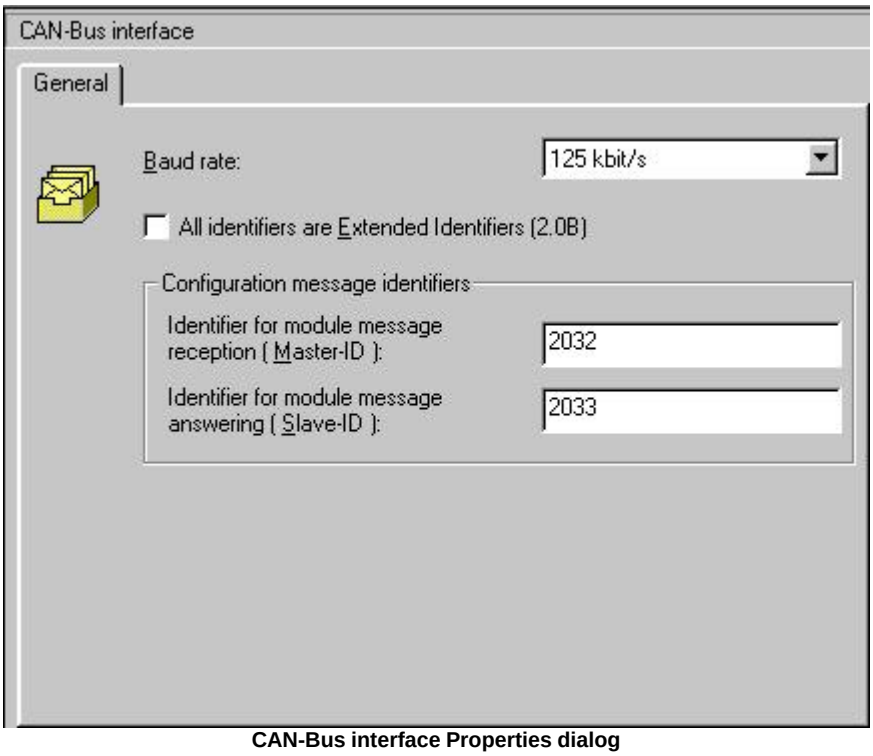
3.2.4.3 CAN-Bus Interface

General bus connection settings are made in the dialog on this virtual index card.

Once switched on, a CANSAS-module sends messages according to its configuration and to the Baud rate set for it. It also receives messages having the correct identifier for configuration messages (Master-ID).

Only one PC having CANSAS configuration software, and no other CAN-node, should transmit on the common CAN-Bus with the Master-ID.

If the CANSAS-module is started with a reset-plug connected, no messages which contain measured data are sent. A Baud rate of 125kbit/s is used and messages with the Standard Identifier 2032 are received.



CAN-Bus interface Properties dialog

Baud rate: The Baud rate is the rate at which individual bits are serially transmitted. All CAN-Bus modules must have the same clock rate. Baud rates from 20kbit/s to 1Mbit/s can be selected from the drop-down list box. The default setting is 125kbit/s.

All identifiers are Extended identifiers (2.0 B): All a module's identifiers, both those of the configuration messages and those of the other messages, can be either Standard identifiers (2.0 A Standard) or Extended identifiers (2.0 B Standard).

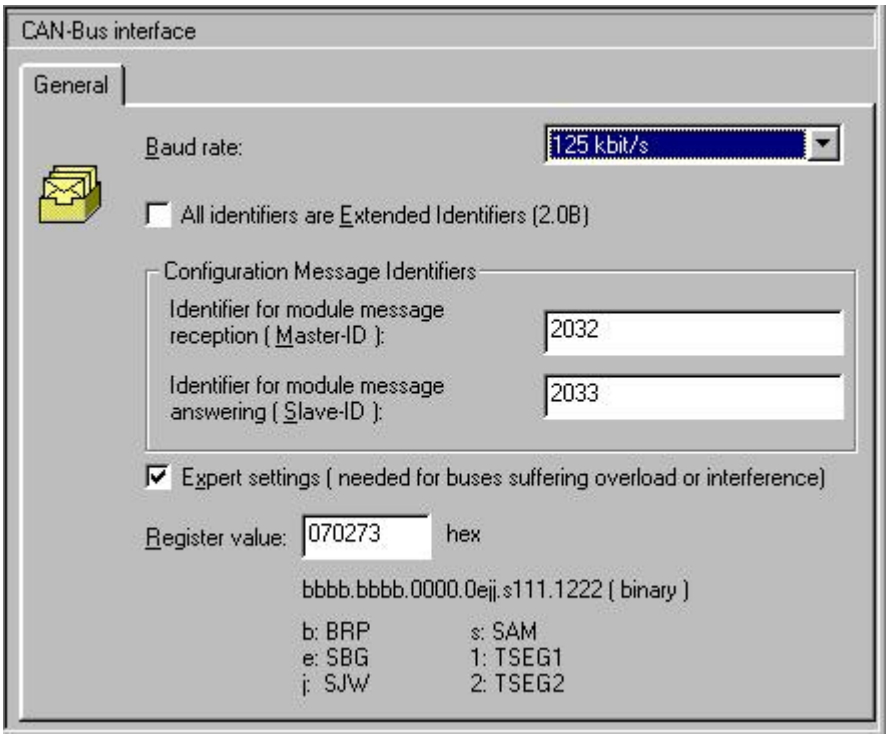
Extended identifiers are 29 bits long (ID's of 0 .. 536870912 are permitted), in contrast to a Standard identifier, which is 11 bits long (ID's of 0 .. 2047 permitted). Extended identifiers can only be used if all nodes of the common CAN-Bus are 2.0B supported or at least 2.0B passive.

Configuration message identifiers: These identifiers are for configuring the CANSAS-modules via the CAN-Bus and normally can keep their default settings.

It can be useful to change an identifier if Extended identifiers are used, or if modules are to be configured from multiple PC's linked to a common CAN-Bus. Each PC in a common CAN-Bus system should have a unique pair of identifiers.

Expert settings: By this means, the baud rate and other parameters which relate to it can be set by directly entering register values.

The expert settings are necessary in case of bus overload or interference, or for setting baud rates other than the selections appearing in the list.



The Register value must be entered as a six-digit hexadecimal number. The first two digits correspond to the bottom 8 bits of "Bit Configuration Register 2" of TMS320F243*. The other four digits correspond to "Bit Configuration Register 1".

The Baud rate is calculated as:

20 M Hz / ((BRP + 1) * (TSEG1 + 1 + TSEG2 + 1 + 1))

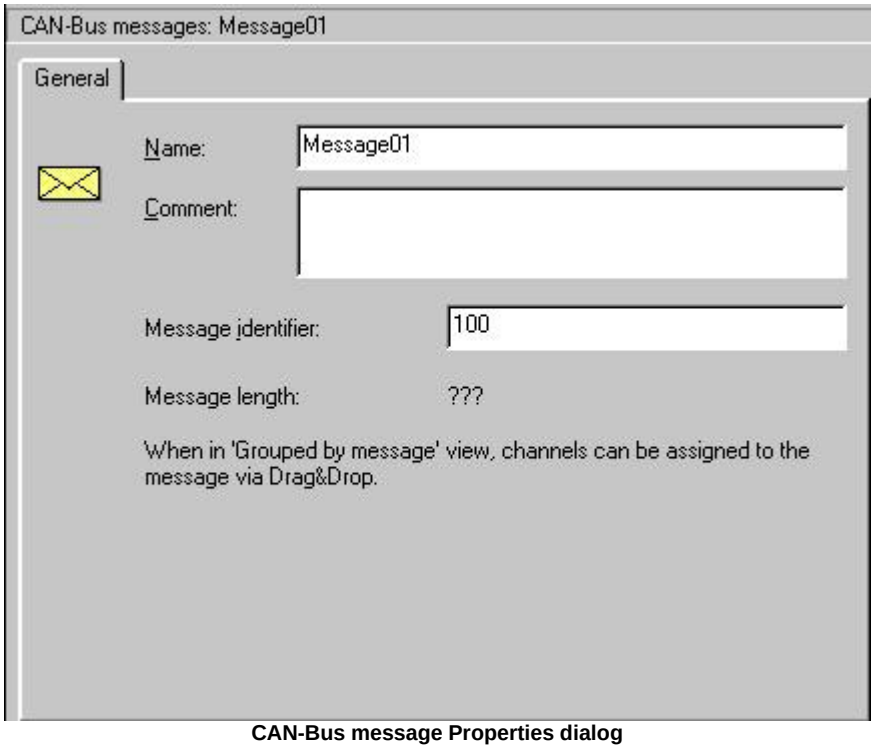
No Baud rates can be set which could not be set together with 16 M Hz.

BRP	7	”Baud Rate Prescaler”
SBG	0	”Synchronization on Both Edges” Should normally be zero: synchronizing to the falling, dominant edge, else to both edges.
SJW	2	”Synchronization Jump Width” Synchronization jump width: 0-3 = 1-4 time quanta
SAM	0	”SAMple point setting” Zero: one sampling value One: three sampling values
TSEG1	14	”Time segment 1”
TSEG2	3	”Time segment 2”

** TMS320F243/F241/C242 DSP Controllers Reference Guide (spru276c)*

3.2.4.4 CAN-Bus message

The dialog on this index card is used to define the properties of a CAN-Bus message.



CAN-Bus message Properties dialog

Name: A unique name by which to differentiate among various messages. As the default, the system suggests _i as the name of a new message, where i stands for the next number not yet used. There are only these limitations to the possibilities for the name:

- there must be a name,
- the name may not contain certain characters. All alphanumeric characters and the characters _ ~ are allowed. The first character may not be a digit,
- the name must be unique within the CANSAS module,
- the name may contain no more than 64 characters.

Comment: An accompanying text about the message; could be used to explain in detail the message name, or for any other notes.

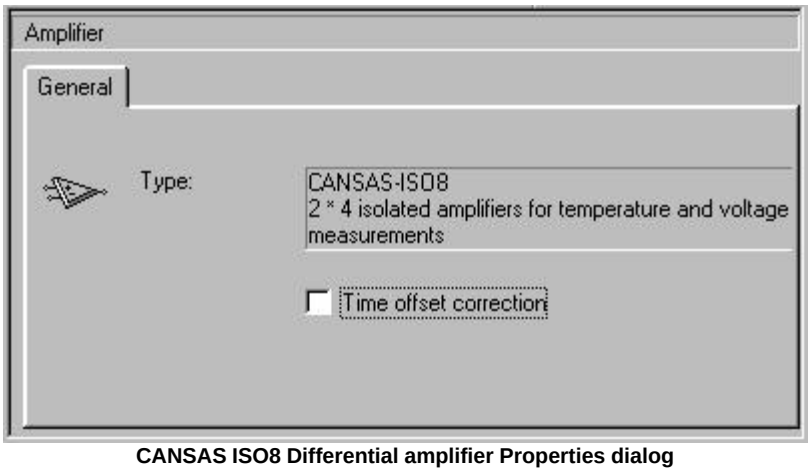
Message identifier: The identifier gives an unequivocal statement of the source and interpretation of data. No two messages of a single module may have the same identifier. The identifier thus determines the priority of sending a message; equal priorities are not allowed. If two messages are simultaneously slated to transmit, the message with the lower-number identifier is sent first. Two messages from different CANSAS-modules may take the same identifier as long as the modules are not connected to the same CAN-Bus. Values which an identifier may take are: 0.. 2047 (Standard-format), 0.. 536870912 (Extended-format).

The identifier can also be defined in hexadecimal format. Append either "h" or "H" to the hexadecimal number, or prefix it with "0x" (e.g. 2ACH, e4h or 0xAC, 0xe4).

Message length: Number of bytes in a message; 1 to 8 bytes are possible. The message length is determined by the channels assigned to it. Only complete bytes can be sent in a message, therefore it is possible that not all bits in a transmitted byte actually contain information from a channel.

3.2.4.5 Input/Output stage

This dialog shows the common properties of the input or output channels. The settings and information this filecard presents depends on the type of module involved.



CANSAS ISO8 Differential amplifier Properties dialog

The dialog elements for each module type are explained in Chapter 4. Here we refer to the C12 module type as an example.

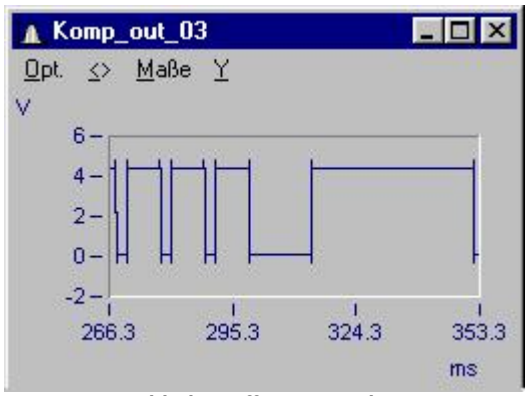
In the case of a CANSAS C12 module, the presence of 12 input channels is indicated. These are organized into two groups of 6, and the six-packs are configured en bloc. All the inputs are DCcoupled, non-isolated differential channels.

The CANSAS C12 module implements time offset correction for the input channels. The check box shown on this dialog lets you activate this option.

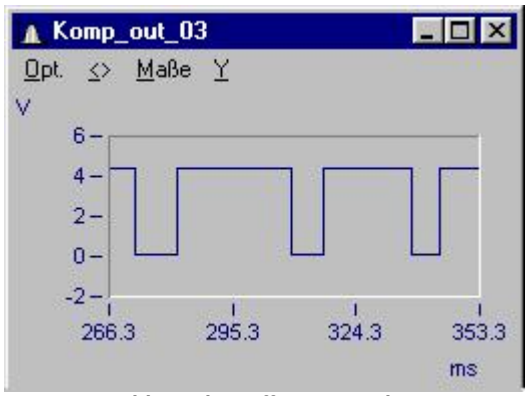
CANSAS C12 Module has two multiplexers for the input channels. This hardware only permits sequential sampling of the input channels, which means that the channels' data have a time discrepancy. This offset is corrected by the software, so that the measured waveforms are practically synchronized. Independently of how many input channels are active, the 12th channel is the control for the offset correction. Interpolation is used to determine the signal value a channel had when the 12th channel's value was recorded.

Note

- The time offset correction should only be used if the signals are sufficiently band-limited to apply the Sampling Theorem. Otherwise, significant errors can result due to aliasing effects.
- The CANSAS hardware allows only sequential sampling of the data acquisition channels (only one multiplexer is provided). Thus, the channels' sampling times are mutually offset, although they all take the same starting time. This offset is compensated for by the software if the option "Time offset correction" is active. Without correction, the time offset is in any case less than the sampling rate set.
- When a rectangular signal is sampled, the FIR-filter causes the signal to appear overshot. You can check whether the effect is real by switching off the time offset correction.



With time offset correction

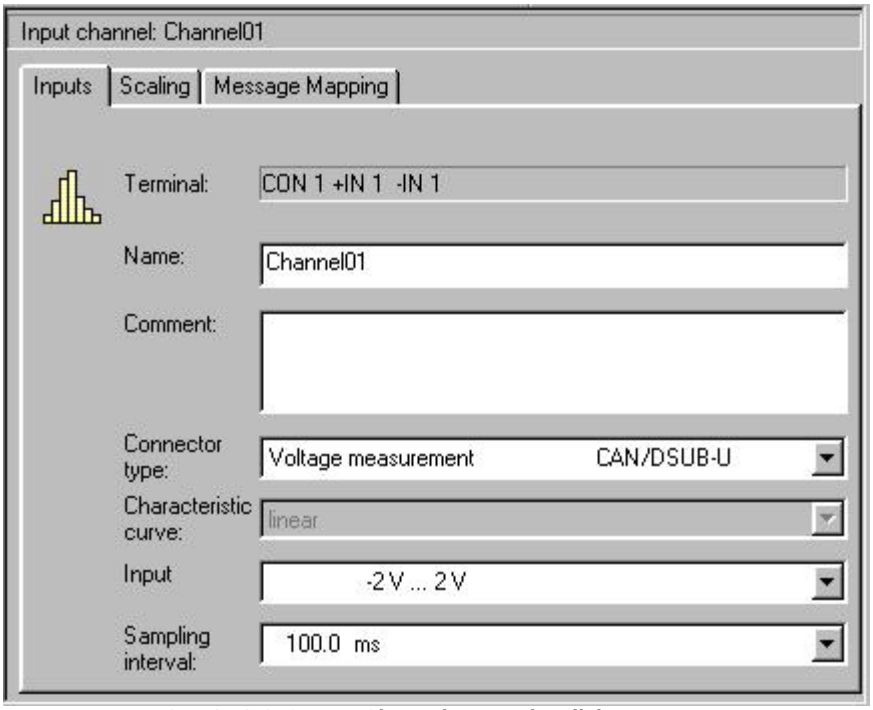


Without time offset correction

3.2.4.6 Input channel

This dialog serves to indicate and to alter the properties of an input channel. The dialog's structure is determined by the type of CANSAS module involved. The following is the dialog for a CANSAS C12 module input channel, for illustration purposes:

The property controls are arranged on three index cards.



CANSAS C12 Input Channel Properties dialog, Page 1

The first page is for defining generalities as the name and comments. The connected device, input range and sampling rate can also be set here.

This discussion will only address the general properties. The module-specific settings are described in the chapter on the Analog-page settings.

The setting **Terminal** indicates which of the two screw terminals the channel inputs are wired at the plug-internal screw terminals.

The **Name** can be specified arbitrarily. It is a means of identifying the channel. There are only these limitations on the possibilities for the name:

- there must always be a name.
- the name may not contain the following characters: \ / : * ? " < > |. A name may not start with dot.
- the name must be unique within the database,
- the name may contain no more than 64 characters.

Incorrect names are displayed in the status bar.

When the cursor is moved away from the input box, the name is updated in the Module Tree.

When multiple channels are selected it's not possible to assign a name.

The box **Comments** is for notes pertaining to the channel.

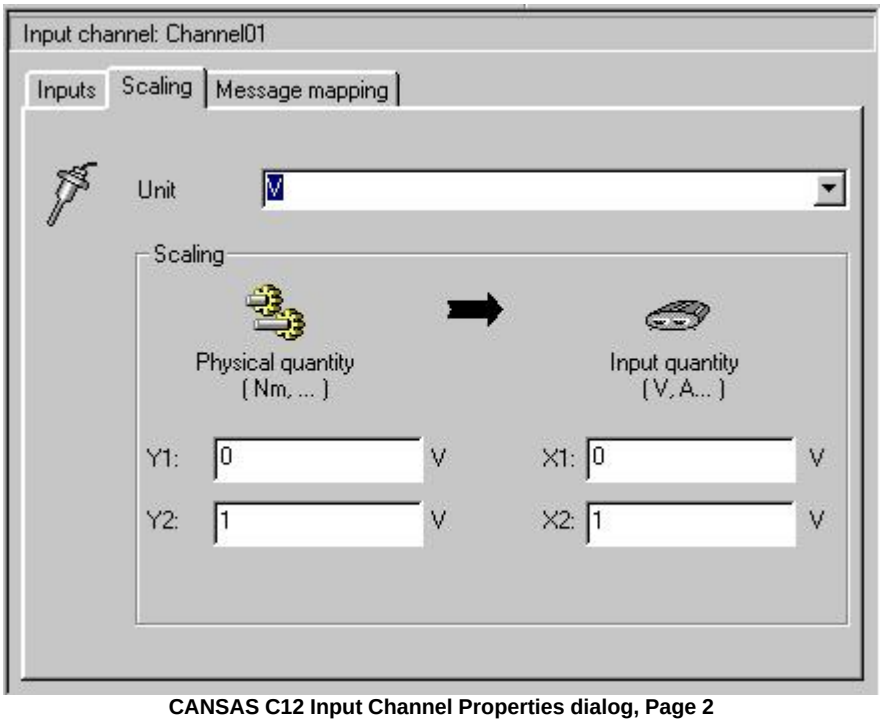
The second page is for setting a custom scaling factor and offset.

In the upper combo box the measurement unit can be set. A unit can be selected from the list or personally entered. Defining the scaling factor is accomplished using a two-point specification:

Custom scaling factor = (Y2 - Y1) / (X2 - X1) ; Custom Offset = Y1 - Custom scaling factor * X1

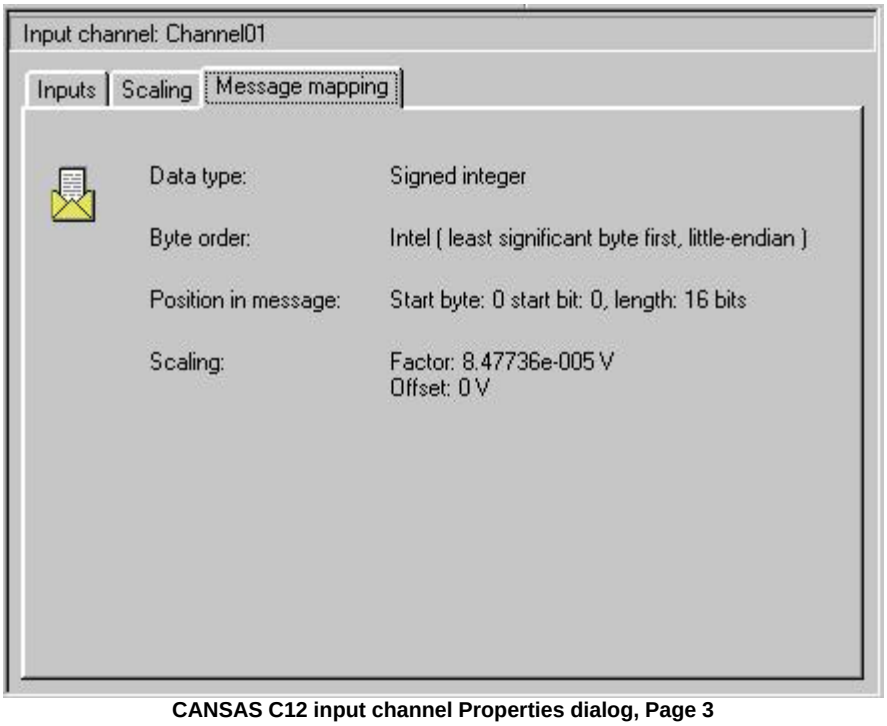
These scaling quantities are then taken account of in the input range indicator on the 1st index card.

Errors will result if X1 and X2 are equal. The faulty entry will be presented in the status bar.



CANSAS C12 Input Channel Properties dialog, Page 2

When temperature measurements are involved, all the controls on this page are disabled. The scaling factor is automatically 1 and the offset is 0. On the third index card, information about the placing of the channel data within the CAN-message is displayed.



CANSAS C12 input channel Properties dialog, Page 3

The message mapping comprises all information needed for a message receiver to read the channel signal.

Data type: Signed integers can be generated. Unsigned integers and digital bits can be generated only by the module types PWM8, DAC8, DO16, DO16R and DO8R.

Byte order: Choices: Intel-format or Motorola-format. In Intel-format, the bits of a number are arranged in order of increasing numerical significance. One a Byte is filled, the notation for the number is continued in

the next higher byte (beginning at Bit 0) until the full measure is reached. The starting bit in Intel-format is the number's Least Significant Bit.

In Motorola-format, the starting bit is the number's MSB. From the starting bit, the bits of a number are arranged in order of decreasing numerical significance. Once a byte is filled, the notation for the number is continued in the next higher byte (beginning at Bit 7) until the full measure is reached. This is then the number's LSB.

The bit order of each format is illustrated by the example below (Start byte: 5, Start bit: 3, number of bits: 18):

Intel-Format: The byte containing the LSB comes first.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5	X	X	X	X	LSB			
Byte 6	X	X	X	X	X	X	X	X
Byte 7				MSB	X	X	X	X

Motorola-Format: The byte containing themsB comes first.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 5					MSB	X	X	X
Byte 6	X	X	X	X	X	X	X	X
Byte 7	X	X	X	X	X	LSB		

Position in message
The message's position depends on the channel's position and on the bit counts of the channels positioned further in front.

Starting byte: In which byte belonging to the message does the number begin? Byte 0 is the first transmitted byte of the CAN-message. In an 8 byte message, then, the bytes 0...7 are available.

Start bit: At which bit in the Starting-byte does the number begin?

No. of bits: Number of bits for the channel. The number is determined by the channel's data type.

For signed and unsigned integers the number is 16 bits.

For floating point numbers it's 32.

For a digital bit, 1.

The bits proceed from the starting bit to the higher-index bytes.

Scaling

The message receiver must factor this value into the channel's signal values in order to obtain the input range set.

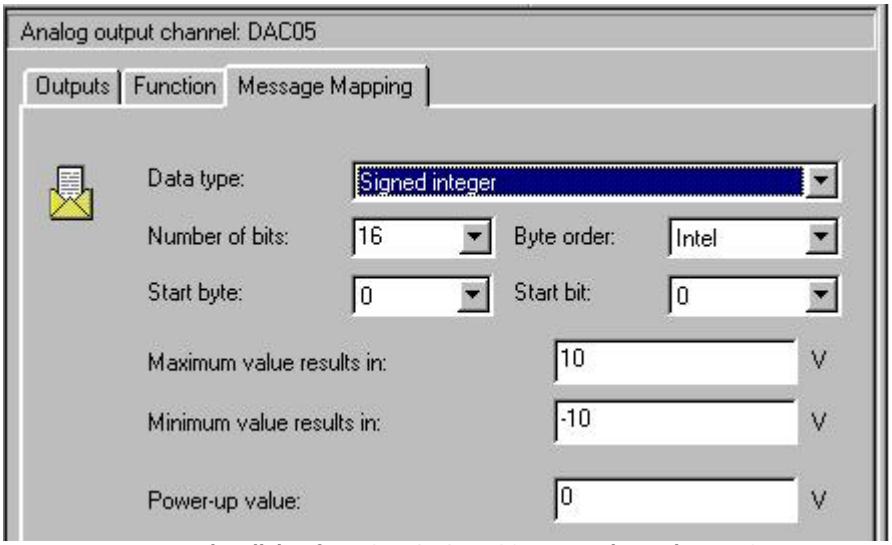
ScaledValue = UnscaledValue * Factor + Offset

3.2.4.6.1 Third output module dialog

The structure of the third card is different for data-outputting CANSAS modules such as DAC8 or RDO8R, and depends on whether or not the channel is assigned to a message.

If the channel isn't assigned to any message, the card is empty except for a notice.

If the channel is assigned to a message, the third card contains controls for letting the user define how the channel's values are to be interpreted from the message.



Properties dialog for a CANSAS DAC8 output channel, page 3

Data type: Signed or unsigned integers or digital bits can be read in.

Number of bits: Number of consecutive bits extracted from the message.

Byte order: Intel-Format or Motorola-Format.

Start byte: In which of the message's Bytes does the number begin? Byte 0 is the first Byte transferred in the CAN-message. Therefore, in an 8-Byte message, 0...7 are available.

Start bit: At which bit in the start Byte does the number begin? Bits 0..7 are possible. Bit 0 is the LSB (least significant bit), Bit 7 themsB.

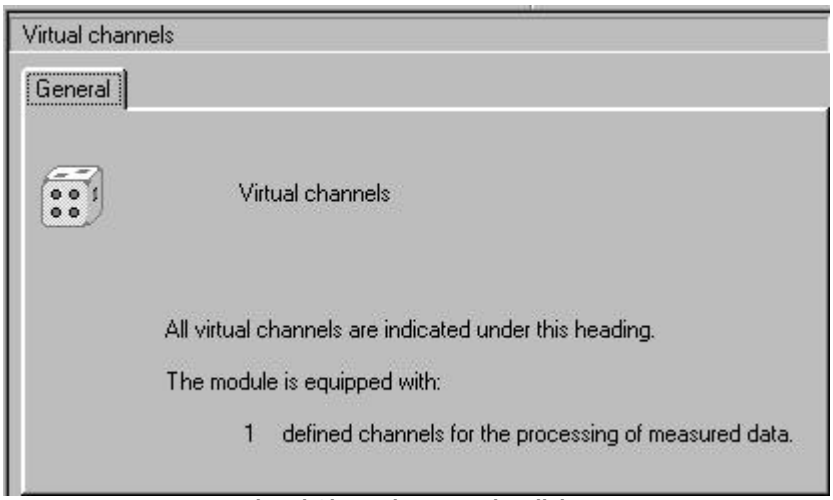
Maximum value results in: The maximum binary number which can be extracted from the message is to be equated to this number.

Minimum value results in: The minimum binary number which can be extracted from the message is to be equated to this number.

Power-up value: This value is used until the first message arrives. It must be consistent with the above specifications for the minimum and maximum values.

3.2.4.7 Virtual channels

This dialog is a summary of all virtual channels. It will only appear if the Module Tree is grouped by channels. Its informational content is the number of defined virtual channels.

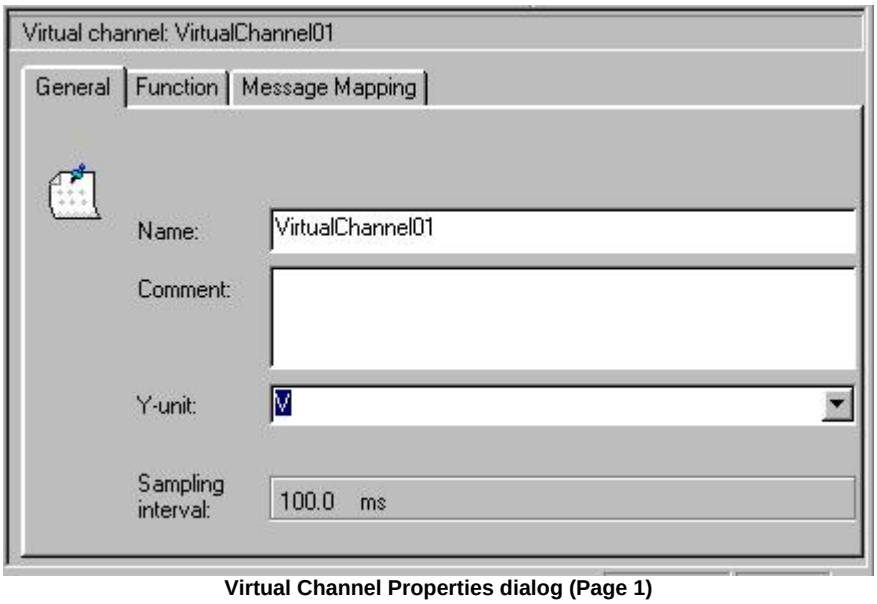

Virtual channels
General
Virtual channels
All virtual channels are indicated under this heading.
The module is equipped with:
1 defined channels for the processing of measured data.

Virtual Channels Properties dialog

3.2.4.8 Virtual channel

This dialog indicates a virtual channel's properties and lets you change them. Use and significance of virtual channels in CANSAS modules is described in the chapter 'Virtual Channels' 67.

The properties' controls are located on three index cards.



Virtual Channel Properties dialog (Page 1)

On the page **General**, the basic virtual channel parameters can be set. These are the channel's name, comment and y-unit. Additionally, the channel's pulse rate is indicated, which can differ from the parameter channel's pulse rate due to the data reduction possibilities.

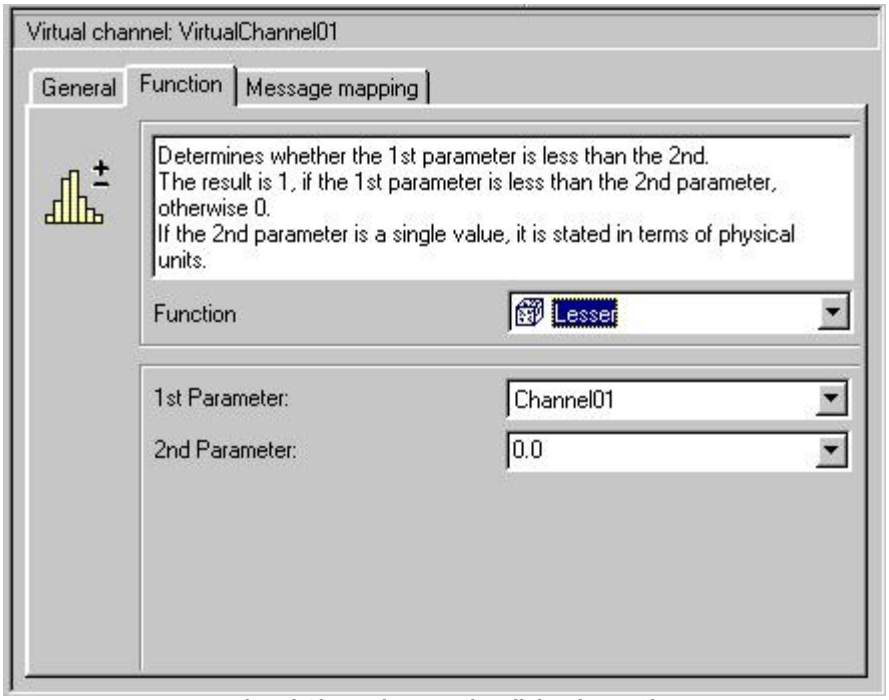
Name: A name unique within the CANSAS-module, so that the channels can be distinguished from each other. Permitted characters include letters, numbers, "_" and "~", where the name's 1st character may not be a number. The maximum name length is 64 characters. The default name for a virtual channel is "VirtualChanneli", i: number of already present virtual channels + 1.

Comment: An accompanying text about the virtual channel. This text can be a detailed explanation of the channel's name or may be used for any other purpose. The comment's maximum length is 255 characters.

Unit: A drop-down list box full of choices for the unit is presented. An arbitrarily set text, having up to 42 characters, can also be entered as the unit.

Sampling interval: The virtual channel's sampling rate, which results from the sampling rates of the channel-function's parameter channels, is indicated. In addition to the parameter channels' sampling rates, data reduction is also given consideration, if applicable.

On the **Function** page, you can specify how the virtual channel's values are computed. For this purpose, a function formula is selected and parameterized.


Virtual channel: VirtualChannel01
General
Function
Message mapping
Determines whether the 1st parameter is less than the 2nd.
The result is 1, if the 1st parameter is less than the 2nd parameter, otherwise 0.
If the 2nd parameter is a single value, it is stated in terms of physical units.
Function
Lesser
1st Parameter:
Channel01
2nd Parameter:
0.0

Virtual Channel Properties dialog (Page 2)

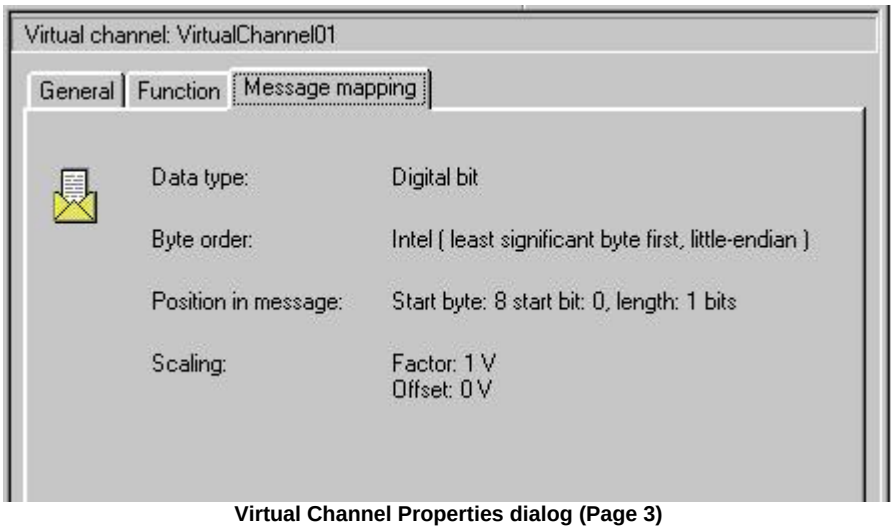
Function: In the drop-down list, the available functions, ordered by function group, are offered (an overview of the computational functions is to be found in the chapter 'Virtual Channels' 67). A help text about the function selected is presented.

Function parameters: In the boxes below the function selection box, the function parameters can be set. A description of the function parameters can be found in the 'Functions Reference'.

The functions usually take one or two channels as their parameters. The channels can be physical channels or other virtual channels. If two channels are specified as parameters they must have the same sampling rate.

If the selected function's expression contains numerical constants or is combined in mathematical operations with parameter channels, it is given in the parameter channel's units. The parameter channel's scaling must be taken into account for the numerical constant.

The page **Message mapping** contains information on the data type, the position in the message and the channel's scaling.



Virtual Channel Properties dialog (Page 3)

3.2.4.9 Special functions

Settings for heartbeat 111, synchronization 112 and if available for CANopen 40®.

3.2.5 Status bar

The Status bar is located at the CANSAS window's bottom edge. The menu item **'View/ Status bar'** lets you toggle the **Status bar** on and off.

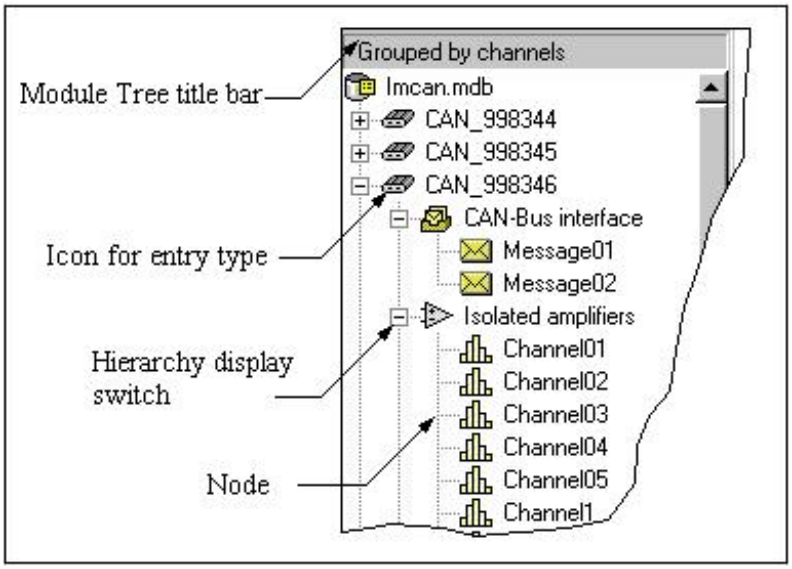
When you move through the menu using the arrow buttons, the left side of the status bar contains a description of the respective menu item's function. Similarly, this area will contain a description of the workings of toolbar softkeys if you click and hold the mouse over such a softkey. If, having read the softkey description, you decide not to use the command, move the mouse cursor off of the softkey and release the mouse button.

If an incorrect input is made, a corresponding error message will appear in the status bar.

The right side of the status bar displays the current time and date.

3.3 Working with the Module Tree

The modules loaded from a database are displayed in the form of a directory tree. Each entry in the tree is accompanied by an icon which indicates the entry's type. The individual entries are attached to the tree by branch-lines. In front of the icons there are little softkeys containing either a plus sign or minus sign, which serve to let you expand or compact a branch.



Module Tree entries

Expanding and compacting entries
Entries which have subordinate entries can be expanded or compacted. The presence of subordinate entries is indicated by the little boxes with either plus or minus signs. A mouse-click on such a box either expands the branch concerned or collapses it; double-clicking has the same effect. The following actions can be initiated from the keyboard:

Key	Action
+ (numeric keypad)	The selected node is expanded by one branching level
- (numeric keypad)	The selected node is collapsed
***** (numeric keypad)	The selected node is expanded through all branching levels
right arrow	The selected node is expanded by one branching level
left arrow	The selected node is collapsed

Selecting entries
One or multiple entries in the Module Tree can be selected at the same time. The properties of the selected entries are indicated in the right segment of the main window.

Clicking the mouse on an entry selects the entry. Clicking over an entry while holding <Shift> selects all entries in a row from the last selected to the present one.

Clicking over an entry while holding <Ctrl> adds it to the group of selected entries, regardless of its location in the tree; or if it is already selected, removes it from the group.

The following actions can be initiated from the keyboard:

Combination of keys	Action
Pos 1	Selects the Database (root) icon.
End	Selects the last entry in the Tree.
Up arrow	Selects the next entry above.
Down arrow	Selects the next entry below.
Right arrow	Selects the first of the subordinate entries.
Left arrow	The next-higher-level entry is selected or the branch collapsed.
PgUp	The topmost visible entry is selected.
PgDown	The bottom-most visible entry is selected.
Shift + End	Multiple selection: all entries from the last selection to the end of the Tree.
Shift + Pos 1	Multiple selection: all entries from the last selection to the top of the Tree.
Shift + PgUp	Multiple selection: all entries from the last selection to the topmost visible entry.
Shift + PgDown	Multiple selection: all entries from the last selection to the bottom-most visible entry.
Shift + Up arrow	Multiple selection: all entries from the last selection to the next entry above.
Shift + Down arrow	Multiple selection: all entries from the last selection to the next entry below.
Ctrl + Up arrow	The focus is directed at the next entry above. The existing selection is retained.
Ctrl + Down arrow	The focus is directed at the next entry below. The existing selection is retained.
Ctrl + <Space>	Toggles the selection on/off in the entry with the focus..
Ctrl + End	The focus is shifted to the end of the Tree.
Ctrl + Pos 1	The focus is shifted to the top of the Tree.
Ctrl + PgUp	The focus is shifted to the topmost entry in the Tree.
Ctrl + PgDown	The focus is shifted to the bottom-most entry in the Tree.

Changing names

The Tree lets you edit the entry names. The following entry types' names can be edited:

- CANSAS module
- CAN message
- input/output channel
- virtual channel

If an already selected entry is clicked over, a small input box appears for editing the text. The editing process is completed by hitting the <Enter> key, or by selecting another entry. Thereafter, the new name is checked by the system and appears in the Properties display.

The editing process can be aborted by hitting <Esc>…

If an entry is in editing-mode, the commands 'Edit/Undo', 'Edit/Cut', 'Edit/Copy' and 'Edit/Paste' are available. In other words, the names can be edited with the help of the Clipboard.

Deleting entries

The following entry types can be deleted from the Module Tree:

- CANSAS module
- CAN message
- virtual channel

When a CANSAS module is deleted, all subordinate entries are also deleted. In order to be deleted an entry must be selected. Multiple entries can also be selected. When the <Del> key is pressed or the menu item 'Edit/Delete' is selected, a prompt for confirmation is posted. Deletion only takes place if the prompt is answered with 'Yes'.

Arranging input channels and virtual channels within messages

The manner of transmitting measurement values via the CAN-Bus is to be defined by assigning positions within messages to the various channels' data.

The assigning process is accomplished in the Tree by the Drag & Drop method.

For this purpose, the Module Tree must be in the mode 'Grouped by Message'. Activating this mode is done using the menu command 'View/Grouped by message'.

The defined CAN-messages are listed under the entry 'CAN-Bus Interface'. Under each CANmessage, the channels whose signals are transmitted in this message are listed. The position within the message's Tree-branch indicates its position within the message.

The bottom-most entry, entitled **Without CAN-Bus message**, comprises all channels not assigned to messages; these will not be transmitted.

Only channels and virtual channels can be re-arranged.

The following Drag & Drop operations are supported:

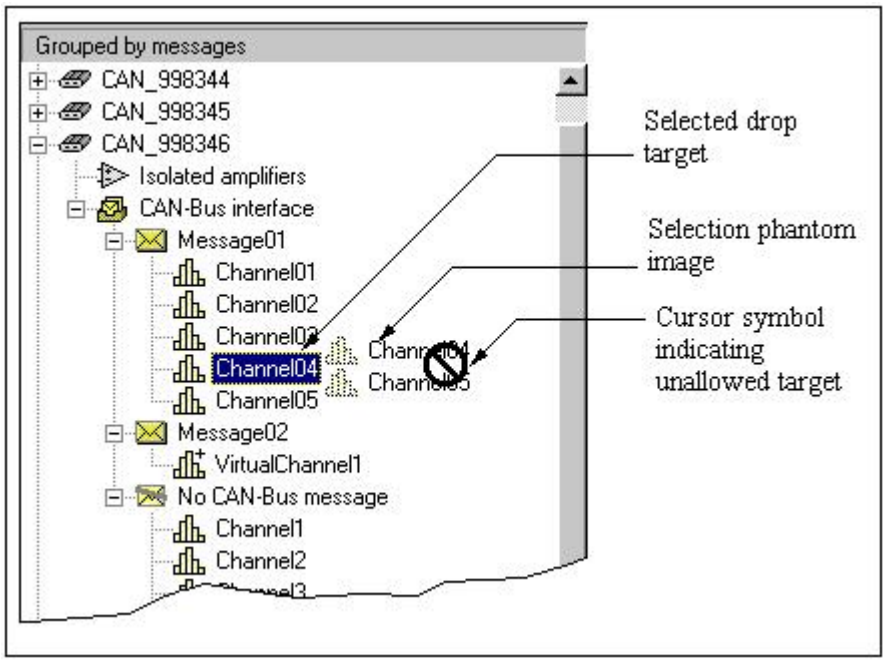
Shifting channels from 'Without CAN-Bus message' into a CAN-Bus message

Shifting channels from a CAN-Bus message into 'Without CAN-Bus message'

Shifting channels from a CAN-Bus message into another CAN-Bus message.

Shifting channels from a CAN-Bus message into another position within the same message.

The Drag & Drop operation can only be conducted within the confines of a single module.



Drag & Drop in the Module Tree

Procedure

Select the entries to be shifted.

The entries can be moved while the left mouse button is held down.

A shadow image of all the entries selected for shifting appears. The cursor gives an indication of whether a dropping destination is permitted. Select the dropping destination. The dragged selections are inserted into the position following the selected dropping destination. If the left mouse button is released on an allowed destination, the shifted entries will 'land' there. Otherwise, nothing happens. The Drag & Drop operation can be aborted by pressing <Esc>.

Obtaining information on the modules

When the mouse pointer is over the entry for a module, a help window appears, in which the module type and serial number is indicated.

Context menu

Right-clicking in the Module Tree opens a context menu which offers the most commonly used functions.

By right-clicking on the Tree's title bar, a context menu appears for toggling between **Grouped by channels** and **Grouped by messages**.

3.4 Menu functions

3.4.1 Files

3.4.1.1 File - New

Purpose: Creates a new module database in CANSAS.

Shortcuts

Toolbar:
Keyboard: CTRL+N

Remarks: Use this command to create a new, empty module database. The dialog 'Save new database as' appears. In this standard Windows dialog you specify the database's name and the directory it belongs to. The file always takes the extension .mdb.

Once the command **Save** is activated, the database has been established. The previously open database is closed and the new database becomes the active one.

Note: The new database is created by copying a database template. The database template is called *empty01.mbd* and should be located in the directory *\TEMPLATE*.

If there is no database template in *\TEMPLATE*, you will be prompted to correct the default directory in the dialog **Set directory for data base template**. In this dialog, the **OK** softkey is only accessible once the template has been located in the directory selected.

3.4.1.2 File - Open...

Purpose: Opening a module database

Shortcuts

Toolbar:
Keyboard: CTRL+O

Remarks: This command lets you open another module database. The standard Windows dialog box Open Database lets you select an already existing database. Module databases always take the extension .mdb.

Once a database is opened, the previously open database is closed. The database's contents are read in and displayed.

3.4.1.3 File - Save

Purpose: Saves the current settings in the module database

Shortcuts

Toolbar:
Keyboard: CTRL+S

Remarks: This command saves all changes to the database.

Saving is also performed automatically before another database is opened and before closing of the program. In these cases, the user is prompted for confirmation of saving.

3.4.1.4 File - Save as...

Purpose: Saves all settings to a different module database

Remarks: A special dialog entitled "Save as" appears, which allows the user to enter a name for the database.

3.4.1.5 File - Import

Purpose: For importing the configurations of CANSAS modules which are stored in files in XML-format.

3.4.1.6 File - Export...

Purpose: For exporting the CAN-configurations of the CANSAS modules selected. The CAN-configuration can be saved either as a CAN-database (*.DBC-files) or as a CAN-Assistant file (*.CBA-file). It is also possible to save in XML-format.

Remarks: Only the CAN-configurations of the selected CANSAS modules are saved in the file format specified, meaning that only messages and channels assigned to these messages are stored. Channels not assigned to any message are not affected. Sensor information (e.g. Baud rate, Standard-/Extended-format) is additionally saved.

With input modules (isolated amplifier-, differential amplifier-, bridge amplifier-, incremental encoder- and digital input modules), the messages are entered into the CAN-Assistant configuration as *Device receives messages*. With output modules (digital relay-, digital output-, analog output modules), the messages are entered into the CAN-Assistant configuration as *Device sends messages*.

CBA-files can be loaded and edited using the µ-MUSYCS CAN-Assistant.

DBC-files can be generated and edited using the program CANdb (© Vector Informatik GmbH) from Vector Informatik GmbH. CANdb is a program for administering the CANalyzer (© Vector Informatik GmbH) CAN system database. DBC-files supported by the CANdb program versions 3.03 to 3.20 are generated. These versions of CANdb belong to the CANalyzer versions 2.0a to 3.0.

When saving in the XML-format, the extension .XML is used. The purpose of such XML-files is to transfer complete configurations (settings) of multiple modules.

3.4.1.7 File - Print

Purpose: Use this command to have the configuration of *either one or all modules* printed out.

Shortcuts

Toolbar:
Keyboard: CTRL+P

Remarks: Calling this command does *not* cause a dialog to appear for selecting a range to print, or anything of the like. The process of printing begins *immediately*, but can be aborted via the progress report dialog which then appears.

Prerequisite: Only a *single* CANSAS module or the *entire* module database may be selected (selecting all of the modules one-by-one also works). If only one among multiple modules is selected, an error message will result.

3.4.1.8 File - Page Preview

Purpose: Use this command to see a preview of the configuration printout as discussed above.

Remarks: Calling this command causes a Page Preview window to be opened on top of the main window. The Page Preview window displays one page of the configuration printout in accordance with the valid printing format. The window's own toolbar offers the ability to page forwards and backwards through the configuration report and to proceed with the printout over a specifiable range of the document and with a specifiable number of copies. It also lets you increase or decrease the size of the display, export the configuration report in various formats for other applications, or update the Page Preview with the database's most recent data. The last option is provided because the main window is still open parallel to the Page Preview window, and changes to the configuration could therefore be made which render the Page Preview window's information obsolete.

Prerequisite: Only a *single* CANSAS module or the *entire* module database may be selected (selecting all of the modules one-by-one also works). If only one among multiple modules is selected, an error message will result.

Procedure: Once the Page Preview window is opened, the softkeys arrayed across the top of the window offer a selection of various commands.

Scroll forwards and backwards through the report [1]

Call the dialog for printing the report [2]

Call the dialog for updating the configuration report with the newest module database data [3]

Call the dialog for exporting the report [4]

Increase/decrease display size [5]

3.4.1.8.1 The 'Print' dialog

The following options let you influence how the document is printed out:

Printing range: Specify which pages of the document to print out:

All prints the entire document

Pages prints a range specified by the controls 'from' and 'to'

Copies: Specifies how many copies of the printing range defined above to print out.

Collate copies prints multiple copies by sequences of report pages, rather than making multiple copies of each page in separate batches.

3.4.1.8.2 The 'Export' dialog

The 'Export' dialog can be used to export the configuration report as a file formatted to be read by other applications. For instance, a report could be exported in the Microsoft Excel format and thus opened in Excel as a normal spreadsheet.

The Export function supports many common word processing, database and spreadsheet formats as well as a number of standard data transfer formats.

Format: This combo box lists all formats in which the report can be exported.

Target: This combo box lists all targets available to the report.

Procedure: In the combo box *Format* the format in which the report is to be exported is specified. For instance, select Excel 4.0 (XLS) from the provided list if you wish to convert the report to Microsoft Excel 4.0 format.

Select an export destination in the combo box *Destination*.

If the report is to be saved in a file, select *file*.

If the report is to be added to an e-mail document as an attachment, an appropriate mail-program must be selected. Microsoft Mail (MAPI), Microsoft Exchange Mail (also called MAPI) and Lotus cc:Mail (VIM) are supported.

If the report is to be saved in a Microsoft Exchange folder, the Exchange folder must be selected from the list.

If the report is to be sent to a Lotus Notes database, select Lotus Notes database from the list.

If the report is to be exported to another application (for instance, MS Excel or Word), select the pertinent application.

Then click OK to start the exporting process.

If the report is exported to a diskette file or an application, a number of dialog boxes appear in which formatting details must be filled in by the user; the particular entries needed depend on the format specified in the dialog *Export*. After these details have been supplied, click OK and the dialog *Select export file* appears. Using the controls in this dialog, a filename and directory path can be specified for exporting the report.

Files receive a program-specific extension when they are exported to particular word processing, spreadsheet or database programs. In contrast, files which are exported in a standard format for data transfer (*.DIF, Data Interchange Format) are automatically assigned the extension *.TXT. However, the program in which the data are to be used may expect an extension different from *.TXT. In the pertinent program's manual you can find the information about which extension to use, and the corresponding extension can be specified in the dialog element *Filename*.

To finish, click on *Save* and the program will export the report to a file in the format specified.

3.4.1.9 File - Print Setup...

Purpose: Use this command to specify a printer and make printer settings.

Remarks: Calling the command makes the Print Setup dialog appear.

3.4.1.9.1 The 'Print Setup' dialog

The following controls are provided:

Printer: Select the printer to use from the list of installed printers. To install a printer or set the port for a printer, use the Windows Control Panel.

Orientation: Choose between Portrait and Landscape.

Paper/Size: Select the size of the paper on which the report is to be printed.

Paper/Source: Some printers have multiple bins for feeding different types of paper to the printer. Select the bin here.

Properties: Calls a dialog offering additional controls for settings particular to your printer.

3.4.1.10 File - Close

Purpose: Ends the CANSAS session.

Shortcuts

Keyboard: ALT+ F4

Remarks: Alternatively, you can close the program from the Close-command in the Control menu, or by simply double-clicking on the Control menu box.

The program will automatically save the latest settings changes to the database without prompting for confirmation.

3.4.2 Edit

3.4.2.1 Edit - Undo

Purpose: Reverses the effect of the last command carried out.

Shortcuts

Keyboard: CTRL+Z

Remarks: You can use this item to undo the last editing action performed, wherever this is still possible. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

3.4.2.2 Edit - Cut

Purpose: Deletes data from an input box and transfers them to the Clipboard.

Shortcuts

Toolbar:

Keyboard: CTRL+X

Remarks: Use this command to remove the currently selected data from the input box to the Clipboard. The command can't be used if there is no current selection. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

Data removed to the Clipboard by this command replace any data which previously were held in the Clipboard.

3.4.2.3 Edit - copy

Purpose: Copies data from a dialog box or module settings to the Clipboard

Shortcuts

Toolbar:
Keyboard: CTRL+C

Remarks: Use this command to copy the currently selected data to the Clipboard. The command can't be used if there is no current selection. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

Data copied to the Clipboard by this command replace any data which previously were held in the Clipboard.

There is another possibility if the entry for a CANSAS module is selected in the Module Tree. In this case, all the settings for the entire module are copied to the Clipboard. Using the command **Edit-Paste**, the settings can then be transferred to another module of the same type

3.4.2.4 Edit - Paste

Purpose: Inserts Clipboard contents into an input box or settings into a different module.

Shortcuts

Toolbar:
Keyboard: CTRL+V

Remarks: A copy of the Clipboard's contents is inserted at the cursor's location. If the Clipboard is currently empty the command is not available. The command only works on the controls of the Properties dialogs and when editing names in the Module Tree.

If module settings are the contents of the Clipboard, they can be applied in the selected module. The command is only enabled if the module type whose settings are in the Clipboard matches the selected module type.

3.4.2.5 Edit - New

Purpose: Adds a new CAN-message or a virtual channel to a CANSAS module.

Shortcuts

Toolbar:

Prerequisite: A single CANSAS module must be currently selected in the Module Tree. If multiple modules are selected, this command is not accessible.

The current selection can also be any of the various entries subordinate to a CANSAS module; the command will always apply to the corresponding module.

The command works in both Module Tree grouping modes.

Procedure: When the command is implemented, the entry for a new ***CAN-Bus message*** is placed under the CAN-Bus Interface node. The message is automatically assigned a name.

If the Module Tree is in the mode Grouped by channels, a new entry is placed under the ***Virtual Channels*** node. If the Module Tree is in the mode Grouped by message, the new entry is placed under the Without CAN-Bus message node.

A name is assigned automatically. Then the program goes into editing-mode; the name can be changed. The changed name is applied once the <Return> key is pressed.

Other properties of the new virtual channel can be set in its Properties dialog.

3.4.2.6 Edit - Rename

Purpose: The name of a CANSAS module, a CAN-message of a channel in the Module Tree can be edited.

Shortcuts

Keyboard: F2

Remarks: The last entry selected can be edited.

3.4.2.7 Edit - Delete

Purpose: Deletes a CANSAS module, a CAN-message or a virtual channel.

Shortcuts

Toolbar:

Keyboard: Del

Prerequisite: Virtual channels, CAN-messages and CANSAS modules can be deleted when they are selected. This function cannot be applied to other entry types.

If the CANSAS module entry is selected (either alone or together with other entries), the module is deleted along with all its subordinate entries.

Deletion of entries means removing them from the database. Using the command 'New', they can be readmitted to the database.

A prompt for confirmation will be posted before the deletion is carried out.

The command works in both Module Tree grouping modes.

3.4.3 View

3.4.3.1 View - Toolbar

Purpose: Toggles the toolbar On/Off

Remarks: When the toolbar is in the 'On' mode, a checkmark appears next to this menu item. The commands symbolized by the toolbar's icons are the most commonly needed commands in CANSAS.

3.4.3.2 View - Status bar

Purpose: Toggles the Status bar On/Off

Remarks: The status bar gives a short description of the workings of the currently selected menu item or currently pressed softkey, and also displays the current time and date. When the status bar is in the 'On' mode, a checkmark appears next to this menu item.

3.4.3.3 View - Split

Purpose: Allows changing the size of the Module Tree window and of the Properties window.

Procedure: After calling this command the mouse or the ARROW BUTTONS can be used to shift the window divider position. As soon as repositioning is complete, click the mouse or press <ENTER> to confirm the position. Pressing <ESC> causes the original window divider position to be restored.

The same effect can be achieved simply by positioning the mouse pointer over the window divider, waiting until the cursor takes on this appearance:

, and moving the mouse to reposition.

3.4.3.4 View - Adjust

Purpose: Alters the Properties window size to accommodate all settings' entries.

Shortcuts

Toolbar:

Remarks: Since the size of the application window is adjustable and the Module Tree window's width can also be adjusted at the expense of the Properties display, it can occur that the Properties display is partly obscured. This command ensures that all elements of the Properties display remain in view.

3.4.3.5 View - Group by

Purpose: Groups the Module Tree entries by message or channels

Shortcuts

Toolbar:

By message: This is a command which restructures the Module Tree. The entries for a module's channels are ordered to reflect their channels' arrangement within the CAN-Bus messages. All defined messages are arrayed under the CAN-Bus Interface entry. There is also still an entry Without CAN-Bus Message, which comprises all channels not yet assigned to a message and which therefore cannot be transferred. Once a CAN-Bus-message's entry is opened, the constituent channels' entries are seen. The order of their listing reflects their arrangement within the CAN-message.

In this mode, channels can be assigned to and deleted from messages by means of Drag & Drop operations.

By channels: This is a command which restructures the Module Tree. The entries of a CANSAS module are sorted into the groups

- CAN-Bus Interface
- Input/output stage
- Virtual channels.

The group **CAN-Bus Interface** contains all defined messages.

The group **(Analog/Digital) inputs** contains all input channels; the group **(Analog/Digital) outputs** all output channels.

The heading **Virtual channels** represents all virtual channels defined as well as certain special channels (LED-triggering).

This mode is more convenient for making simultaneous settings for input/output channels and virtual channels.

Note: In this mode, it's not possible to assign channels to messages. For that purpose, use the Grouped by Message mode.

3.4.3.6 View - Expand all branches/Collapse all branches

Purpose: Show or hide all branches of the module tree.

Shortcuts: Ctrl + Num + / -

3.4.4 Module

3.4.4.1 Module - Integrating Assistant

Purpose: Incorporates a new CANSAS-module into the module database. This can be done either by accessing an actually existing module via the CAN-Interface (on-line) or by making an entry manually (off-line).

Shortcuts

Toolbar:

Prerequisite: For on-line module integration, a supported hardware CAN-interface must be installed. The interface is selected and its parameters set in the dialog for the menu item *Extras/ Interface*. If this hasn't been done, the Integration Assistant will be closed after posting a corresponding message in explanation. Also, the CANSAS-module must be correctly connected to the CAN-Bus and ready to run.

Integrating-Assistant
How to search for new CANSAS-modules?
Integration of multiple modules:
Multiple CANSAS-modules may be connected to the CAN-Bus, which all are to be detected. They must all have the same Baud rate.
Single integration:
Single integration can only be selected, if the Reset-connector is used. Only a single CANSAS-module can be connected at the CAN-bus.
Offline integration:
A CANSAS-module is integrated manually without an available CAN-Bus.
< Back
Next >
Cancel

For the module integration procedure, only the module to integrate may be currently connected to the bus involved. It's recommended to make a direct connection to the PC rather than going via the bus-complex.

Procedure: Integration of a module is accomplished with the help of the *Integration-Assistant's* sequence of dialogs. The softkeys *Next* and *Back* can be used to proceed to either the next step or the previous one. In the dialog succeeding the introductory dialog, the decision is made whether the module to integrate is accessed on-line:

Single integration: Integrates a new module on-line.

Choose *this option* to use this program to make the settings for a *newly purchased* CANSAS-module.

This is the preferable way to proceed as long as you have an actual module to integrate; the entry of the module's parameters will be handled automatically and the database settings will be compatible with the module.

Integration of multiple modules: It's possible to connect multiple modules, but they must all have the same Baud rate and firmware. If this is not the case, proceed as follows:

1. Use Single integration to find the modules one at a time.
   a. Give each of them the same Baud rate, Master – and Slave-ID.

b. If you don't know what Baud rate the modules are set to, use the Reset plug to set them back to the factory setting (125kBit). To do this, attach the Reset plug to the module and then briefly disconnect the module from its power supply.

c. If necessary, a firmware update is performed.

2. Once all the modules are using the same Baud rate, Master- and Slave-ID, they can all be connected to a common CAN-Bus.

a. The bus will only work without errors if all the modules are using the same Baud rate.

b. For working with one CAN-module, it doesn't matter which Master or Slave-ID it's using. However it's absolutely necessary for all modules to use the same IDs if they are integrated by means of *Integration of multiple modules*. We recommend setting the Master to ID= 2 and the Slave to ID=3, which are the default settings.

c. Make sure that the ends are terminated with 120 Ω terminators.

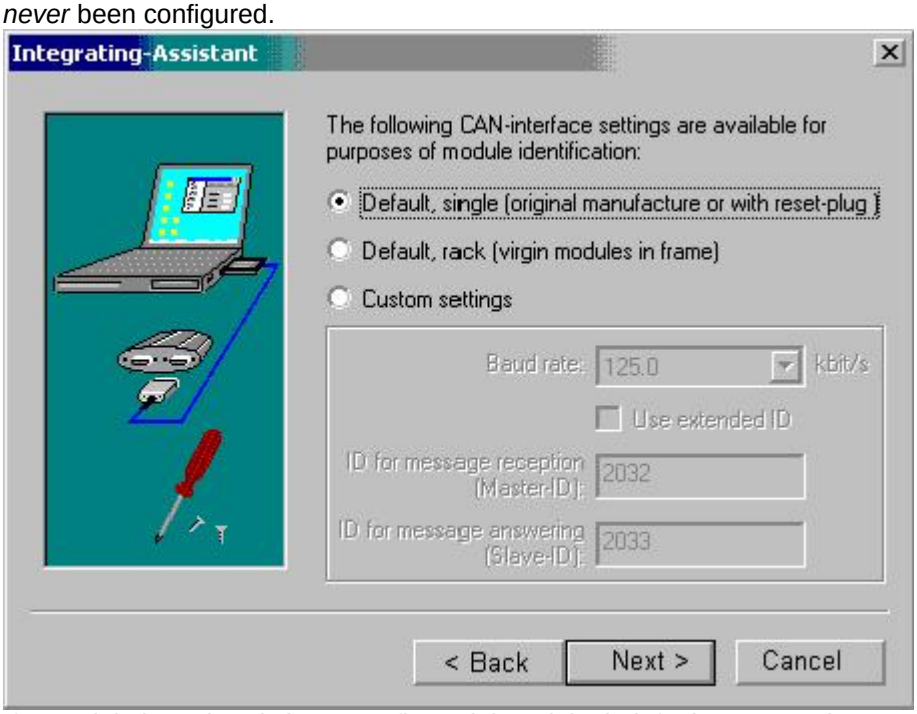
Having followed these instructions, it will be possible to take measurement with multiple modules.

Offline integration: This is the only option if no CANSAS-module is currently available to connect to the system; this is mainly for demo purposes.

If you wish to use this option to make all settings for a genuine CANSAS-module manually, rather than automatically as above using *Yes*, then it is crucial that the module's serial number and type are entered exactly, AND that the module's Baud rate be the same as the default Baud rate.

The ensuing sequence of dialogs presented by the Assistant depends on the choice between on-line and off-line; the description below illustrates the on-line case. In the first instance, the module's CAN-interface settings are made.

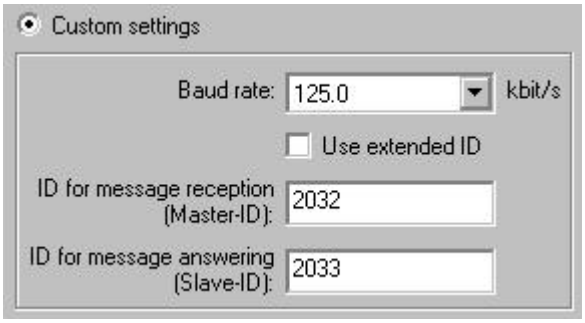
Default, single: The module's Baud rate and ID numbers for communication with the PC are assumed to take the default values. This is the case when a module is fresh from manufacture, in other words, if it has *never* been configured.



If a module has already been configured, its original, default state can be restored at any time by inserting the special Reset-plug at either of the module's CAN IN or CAN OUT terminals. The power supply must be off while the plug is inserted. Once the power is re-connected, the CANSAS-module works with its default settings as long as the Reset-plug is in place. To permanently reinstate the default settings, the module must be configured with them.

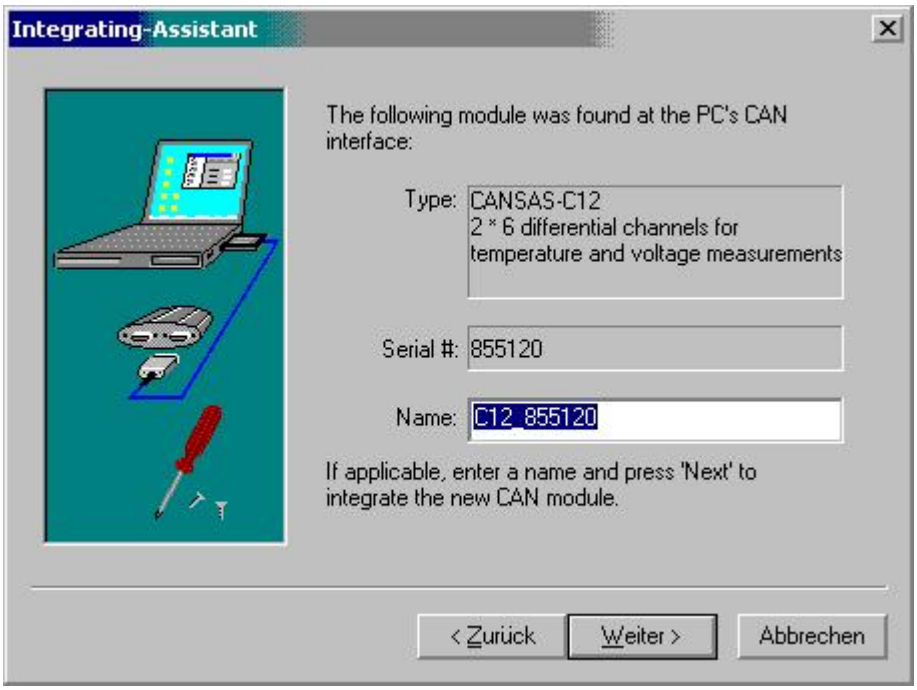
Default, rack: Default settings for a new modules used in a rack. Baud rate is 500 kbit/s; Ids are 2 for receiving and 3 for send messages.

Custom settings: The module's Baud rate and ID-numbers for communication with the PC can also be specified personally. But the values absolutely must match those valid for the module in order for the module to be recognized by the system. This is especially true of the Baud rate, which tends to be reconfigured more often than the ID-numbers! Note that only standard Baud rates can be selected here. This means that a module configured with a special Baud rate using *Expert settings* can only become a default-setting module by means of a Reset-plug!



Next: The next Assistant dialog prompts you to confirm the instruction to proceed with identification of the module via the PC's CAN-interface. The process can take some time. This is especially true if the PC-interface had not yet been used by the CANSAS program in the course of the session, since the interface initialization process still must take place beforehand.

Once identification is completed, the next dialog appears. This is the same dialog which would appear right after *No* (or: off-line) is selected. The dialog contains the settings which distinguish the module in the database:



Type: The CANSAS-module's type, e.g. *6 * 2 differential input channels*.

When using the *on-line* option for integrating a module, this setting is handled automatically and cannot be changed.

In the *off-line* case, a selection must be made in the combo-box.

Serial number: The CANSAS-module's unique serial number, set at production.

When using the *on-line* option for integrating a module, this setting is handled automatically and cannot be changed.

In the *off-line* case, any number from 1 to 999999999 can be freely selected. If you are making settings for an actual module 'manually', however, the true serial number must be used.

Name: A unique name by which the CANSAS-module is designated in the database.

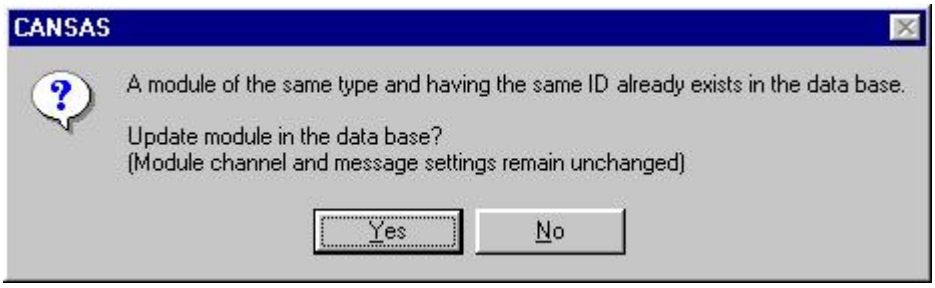
When using the *on-line* option for integrating a module, a default name, which is derived from the serial number, is offered. However, if the serial number in question is already registered in the database, the module name noted there is offered as the default.

Specifying and changing the name is permitted as long as the name is unique within the database.

Next: Completes the module-integration process. The data for the module are incorporated into the database.

If the data do not conform to accepted limitations, an error message will appear and signal a return to the previous dialog. Otherwise, the settings must be confirmed by pressing the softkey *Finish*. Once this is done, the module is integrated and can be configured using the software.

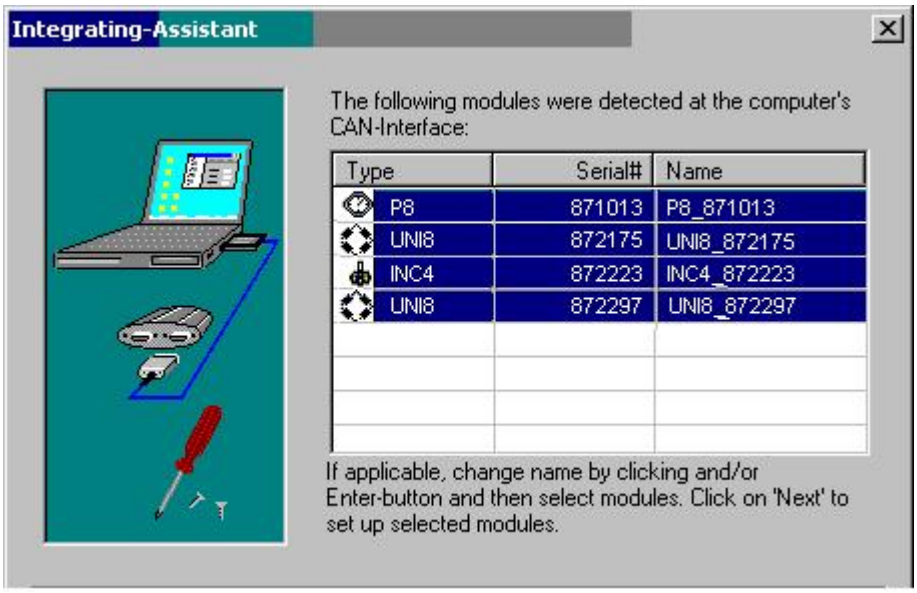
If a CANSAS-module of the same type and serial number is already registered in the database, the system asks whether the Baud rate, Master/Slave-ID and module ID numbers are to be updated, in other words, to be overwritten:


CANSAS
A module of the same type and having the same ID already exists in the data base.
Update module in the data base?
(Module channel and message settings remain unchanged)
Yes
No

If a CANSAS-module of the same serial number but a different type is already registered in the database, the system asks whether the module is to be (completely) overwritten, including the channel and message settings:

When using the *on-line* option for integrating a module, this can never occur, since the serial number is unique and the serial number and module type are entered automatically. Only in the *off-line* option can this case arise.

When multiple modules are integrated, the following overview is displayed:



Select all modules you wish to enter into the database. Then press "More".

Note: If a new update of the software is used and the modules still have the firmware for Software Version 1.2, a search for all modules on the bus will not work. In that case, simply load your existing database and reconfigure the modules. In this process, the firmware is updated.

3.4.4.2 Module - Find selections...

Purpose: Checks whether CANSAS-modules registered in the database are connected to the CAN-Bus.

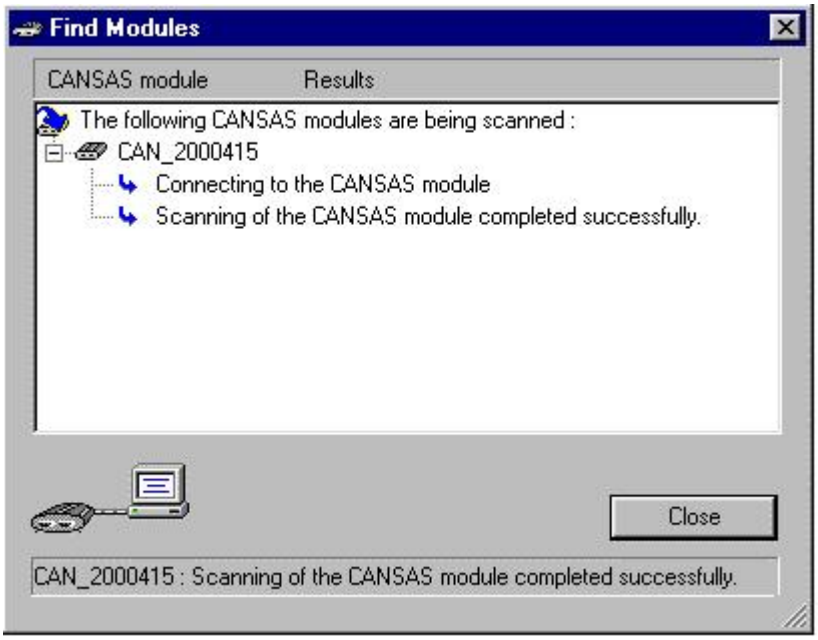
Shortcuts

Toolbar:

Prerequisite: One or more CANSAS modules must be currently selected in the Module Tree. The search performed always affects all modules selected. It is enough to select a subordinate entry of a module to make the module involved count as selected. If the entry for the database is selected, a search for all modules belonging to the database is carried out.

Remarks: The search is accomplished using the dialog Find Modules. The search starts immediately.

The first stage comprises a check of whether the corresponding CANSAS module is connected to the CAN-Bus.


Find Modules
CANSAS module
Results
The following CANSAS modules are being scanned :
CAN_2000415
Connecting to the CANSAS module
Scanning of the CANSAS module completed successfully.
Close
CAN_2000415 : Scanning of the CANSAS module completed successfully.

Once a functioning connection has been established, the firmware version, hardware version and batch number are read out of the module. These properties are later indicated in the Properties dialog for each module.

If an error is detected at any stage of the search, this is indicated in the dialog. There is also an indication of any module which is found, and the search for the next module proceeds. The search can be aborted by pressing the **Stop** softkey.

When the dialog is closed, the Module Tree is updated. Modules located in the bus system are denoted by the symbol .

3.4.4.3 Module - Check configuration

Purpose: Checks for errors in the configuration set for the CANSAS module.

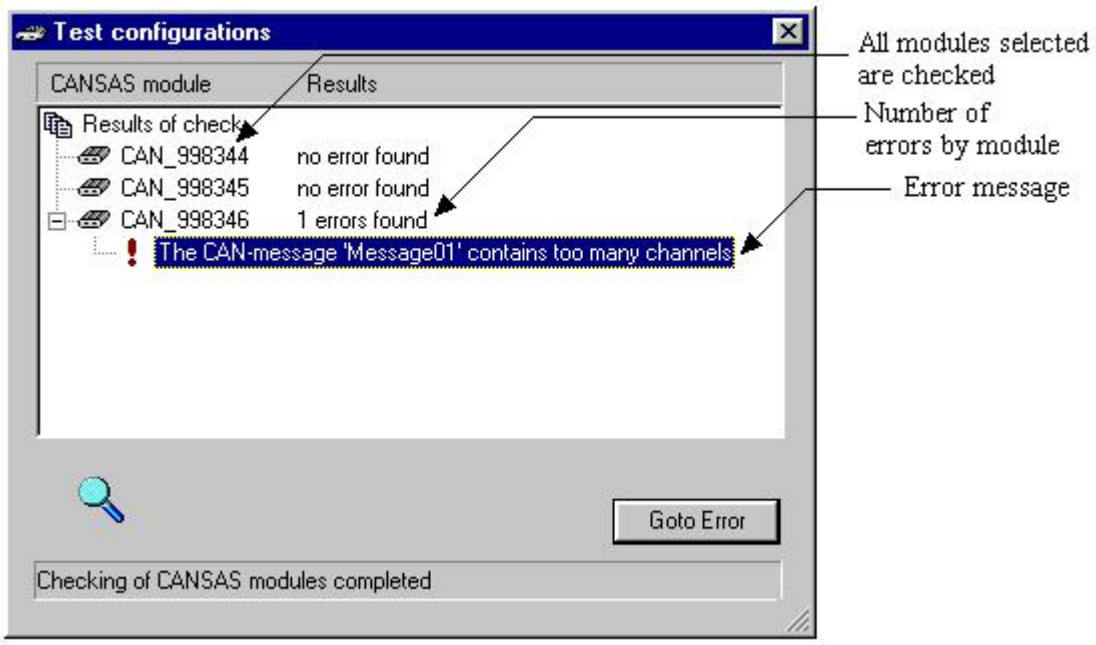
Shortcuts

Toolbar:

Prerequisite: One or more CANSAS modules must be selected; all modules selected are checked. The module itself or any subordinate entry can be selected; the function is applied to the module affected. If the Database entry is selected, all the modules will be checked.

Remarks: Calling the command makes the window "Test configurations" appear. The tests are started immediately.

The tests are carried out without accessing the interface and module.



The Test configurations dialog

Each CANSAS module is tested on the following points:

- CANSAS- module names
- CAN-message names and channel names
- CAN-Bus Interface settings
- CAN-Bus messages
- Virtual channels
- Input channels
- Module computational capacity
- Occupation of bus capacity by the module

If an error is detected, an error message is posted under the entry for the module affected. The system attempts to find and indicate any configuration errors. Once the tests are completed, one of the errors found can be selected. By pressing the softkey **Go to error**, the source of the error is selected in the Module Tree (this can also be accomplished by double-clicking the error's listing). This way, the error can be corrected by changing the appropriate setting in the Properties dialog.

☞ **Note**

A CANSAS module can only be configured if the test is carried out successfully.

3.4.4.4 Module - Configure...

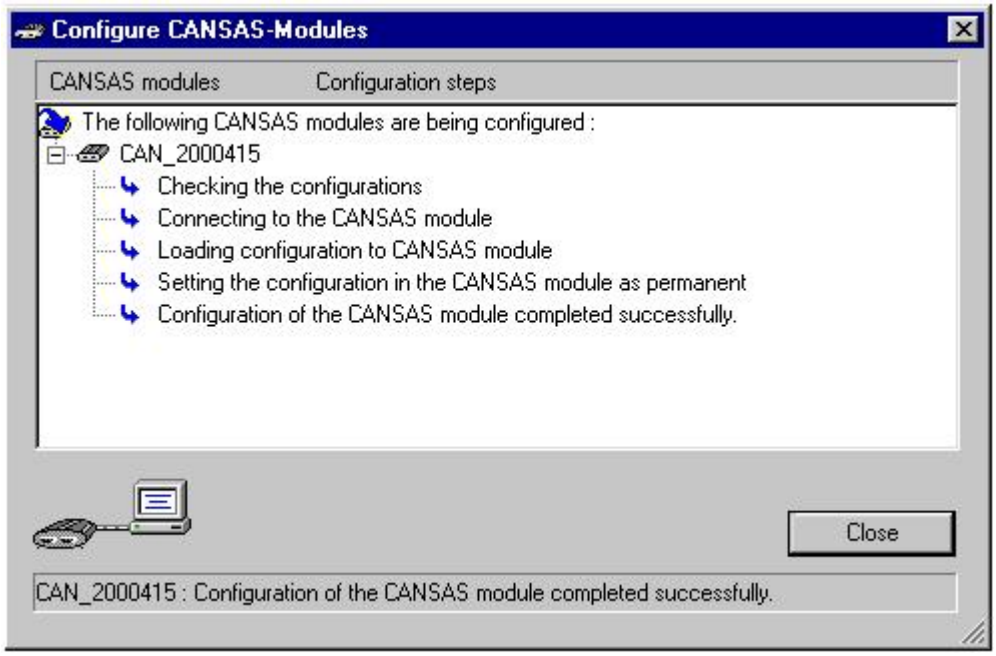
Purpose: Writes the configuration to the module.

Shortcuts

Toolbar:

Prerequisite: One or more CANSAS modules must be currently selected in the Module Tree. Configuration performed always affects all modules selected. It is enough to select a subordinate entry of a module to make the module involved count as selected. If the entry for the database is selected, all modules belonging to the database are configured.

Remarks: Configuration is accomplished using the dialog Configure CANSAS-modules. The process starts immediately.


Configure CANSAS-Modules
CANSAS modules
Configuration steps
The following CANSAS modules are being configured :
CAN_2000415
Checking the configurations
Connecting to the CANSAS module
Loading configuration to CANSAS module
Setting the configuration in the CANSAS module as permanent
Configuration of the CANSAS module completed successfully.
Close
CAN_2000415 : Configuration of the CANSAS module completed successfully.

The Configure CANSAS-modules dialog

The configuration process includes a check of the settings. The same testing algorithm is used as for the command **Edit/ Check configuration....**. If multiple modules are to be configured, they are all first tested. If an error is detected in any module, configuration is canceled.

The next step consists of checking whether the CANSAS module is connected to the CAN-Bus. Once a functioning connection has been established, the module's firmware version is compared with the firmware file.

CANSAS
The directory 'E:\TEST\CANSAS\FIRMWARE\' does not contain firmware files.
Use the following dialog to select the appropriate directory.
OK

If a discrepancy between the file firmware version and the module firmware version is discovered, the firmware must be loaded into the module and made permanent there. If the firmware file's version is older than that of the module, a prompt will be posted beforehand for confirmation that the older version should be loaded in the module.

Now the configuration noted in the module is compared with the configuration set in the PC. If they are the same, no configuration is loaded into the module; otherwise the new configuration is loaded into the module and made permanent there.

If an error is detected during the configuration stage, this will be indicated in the dialog. Configuration is resumed in the next module. By pressing the soft key **Stop**, the user can abort the configuration process, if desired.

3.4.4.5 Module - Measure...

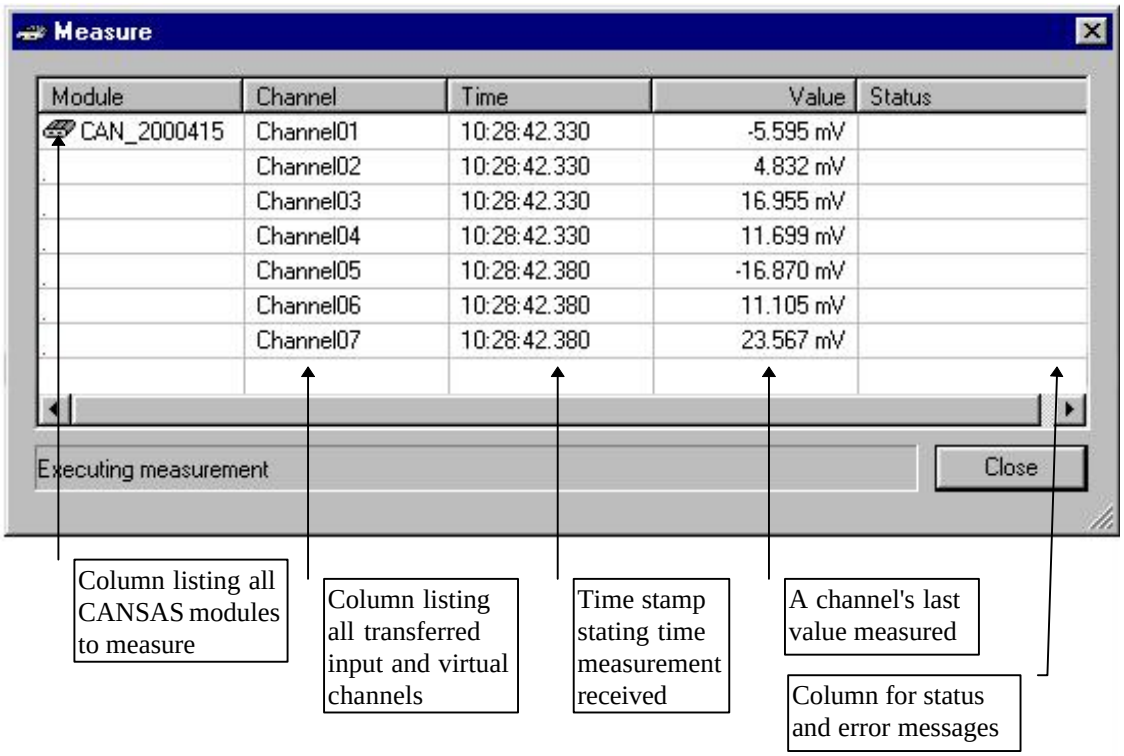
Purpose: Measurement data are read from the module.

Shortcuts

Toolbar:

Prerequisite: The CANSAS modules from which measurement data are to be read must be selected in the Module Tree.

Remarks: Calling this command causes the Measure dialog, as shown below, to appear:



Before actual measurement proceeds, a check of the firmware and the module configuration is performed automatically. If these are not compatible, a corresponding error message is displayed in the status bar. Measurement by the module affected cannot be carried out; it would be necessary to perform the command **Module/ Configure...** in preparation.

The displayed measurement values are constantly updated. The measuring process can be ended by selecting the menu item **Close**.

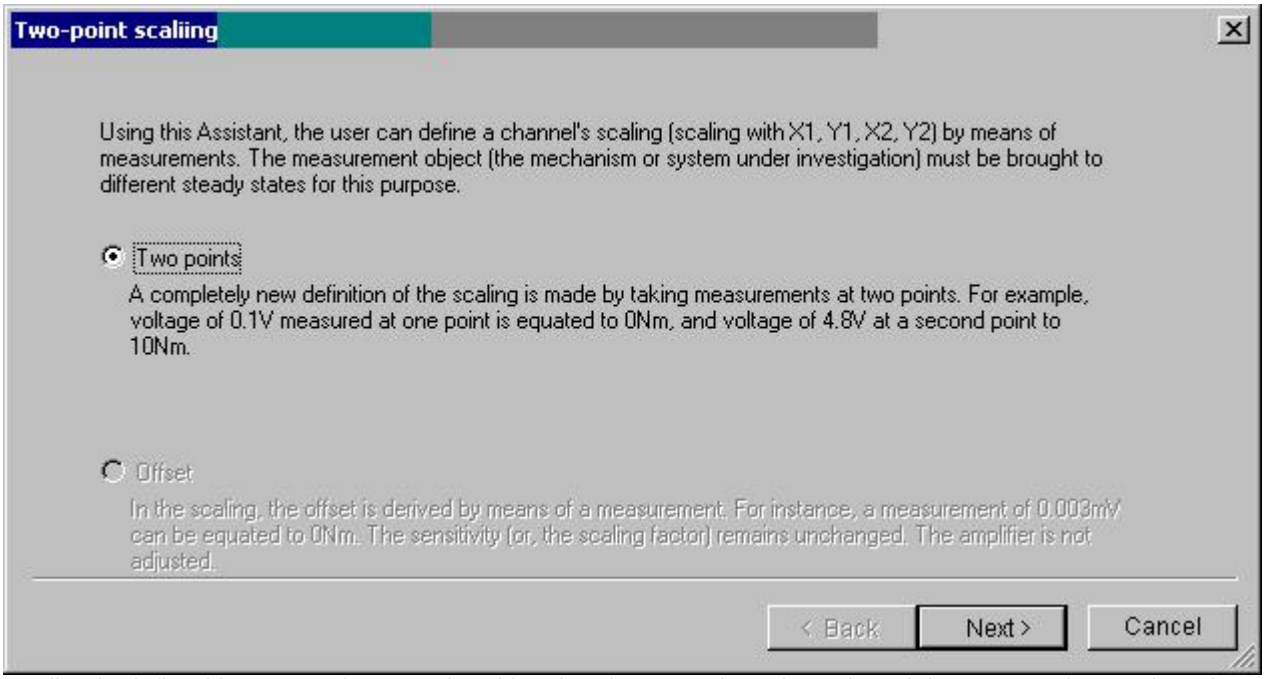
If the system running a measurement includes BRIDGE2 modules, the commands under the menu **Bridge amplifier** are enabled. The command **Perform balance** causes all BRIDGE2 modules' bridges to be balanced automatically. The command **Trigger shunt calibration** causes the bridges of the BRIDGE2 modules to be shunted. The bridges are thus trimmed in a defined way for a certain time. The command is useful for performing a function check.

The **Output modules** menu plays a role in DO and DAC8 modules.

With these modules, the entry in the column **Measurement/output value** can be edited. Pressing the Enter- key switches to edit mode. The output value can be edited. Pressing the Enter- key then confirms the new value and applies it in the module. The Esc- key can be used to abort the new entry.

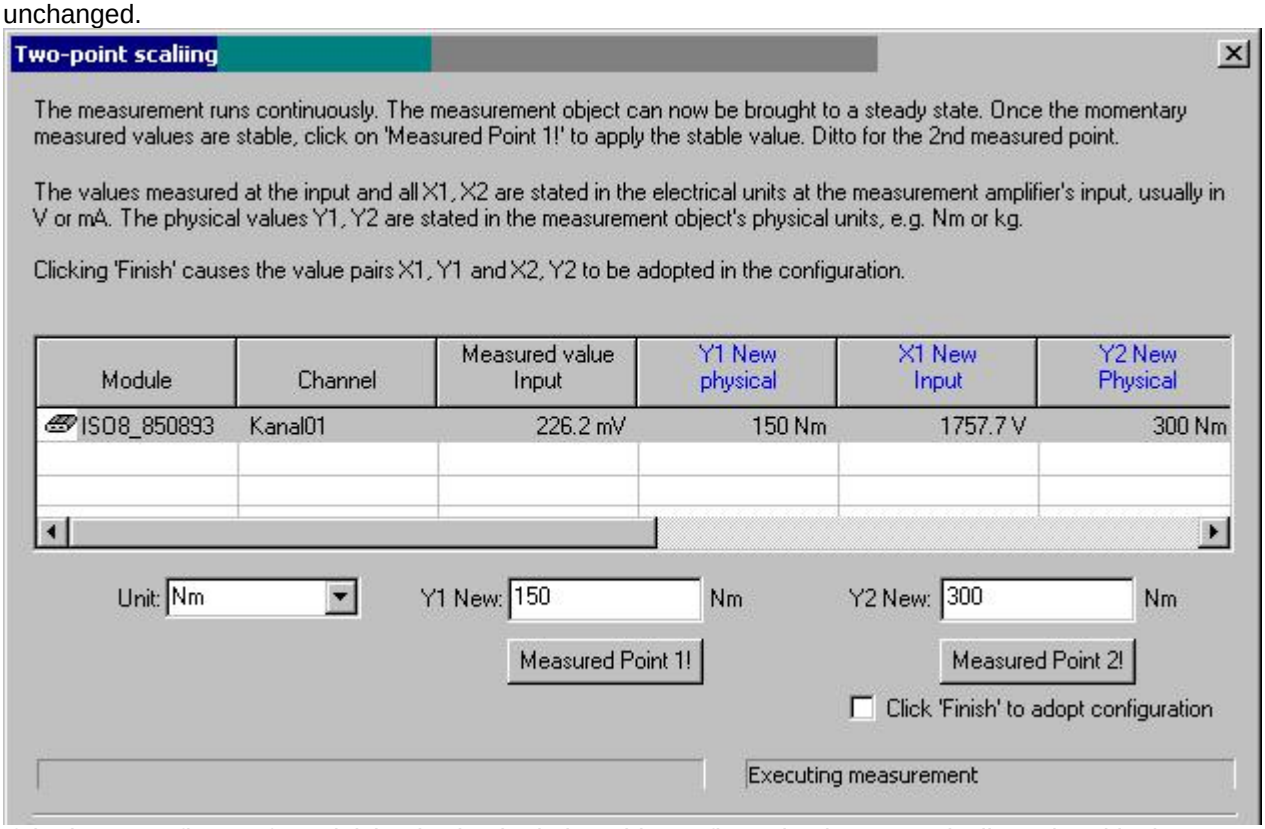
3.4.4.6 Module - Two-point-Scaling

Purpose:


Two-point scaliing
Using this Assistant, the user can define a channel's scaling (scaling with X1, Y1, X2, Y2) by means of measurements. The measurement object (the mechanism or system under investigation) must be brought to different steady states for this purpose.
Two points
A completely new definition of the scaling is made by taking measurements at two points. For example, voltage of 0.1V measured at one point is equated to 0Nm, and voltage of 4.8V at a second point to 10Nm.
Offset
In the scaling, the offset is derived by means of a measurement. For instance, a measurement of 0.003mV can be equated to 0Nm. The sensitivity (or, the scaling factor) remains unchanged. The amplifier is not adjusted.
< Back
Next >
Cancel

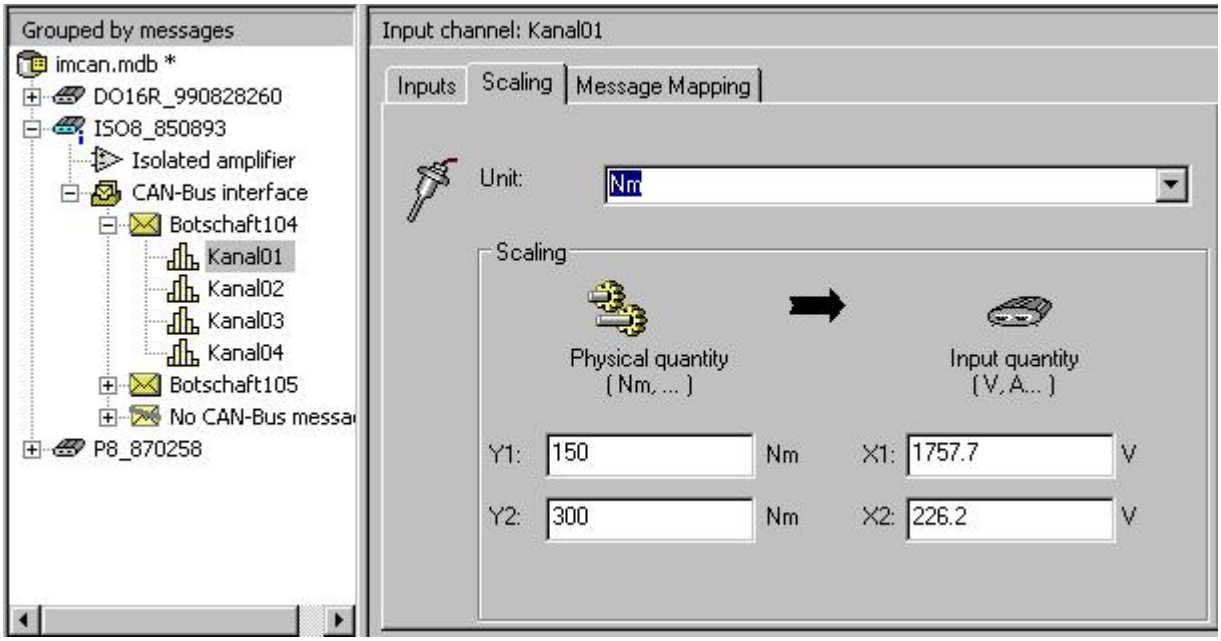
Scaling is defined by measuring two signal levels. The user gives the unit and the expected set point. The two points will be measured in succession and entered with the buttons *Measured Point 1!* and *Measured 2!*.

In the Assistant mode *Offset*, only the scaling offset is recomputed while the scaling factor remains unchanged.


Two-point scaliing
The measurement runs continuously. The measurement object can now be brought to a steady state. Once the momentary measured values are stable, click on 'Measured Point 1!' to apply the stable value. Ditto for the 2nd measured point.
The values measured at the input and all X1, X2 are stated in the electrical units at the measurement amplifier's input, usually in V or mA. The physical values Y1, Y2 are stated in the measurement object's physical units, e.g. Nm or kg.
Clicking 'Finish' causes the value pairs X1, Y1 and X2, Y2 to be adopted in the configuration.
Module
Channel
Measured value Input
Y1 New physical
X1 New Input
Y2 New Physical
ISO8_850893
Kanal01
226.2 mV
150 Nm
1757.7 V
300 Nm
Unit: Nm
Y1 New: 150 Nm
Y2 New: 300 Nm
Measured Point 1!
Measured Point 2!
Click 'Finish' to adopt configuration
Executing measurement

If the box "Configure after 'Finish' " is checked, then this configuration is automatically updated in the module after exiting the dialog.

The scaling values can be checked on the *Scaling* tab afterwards.

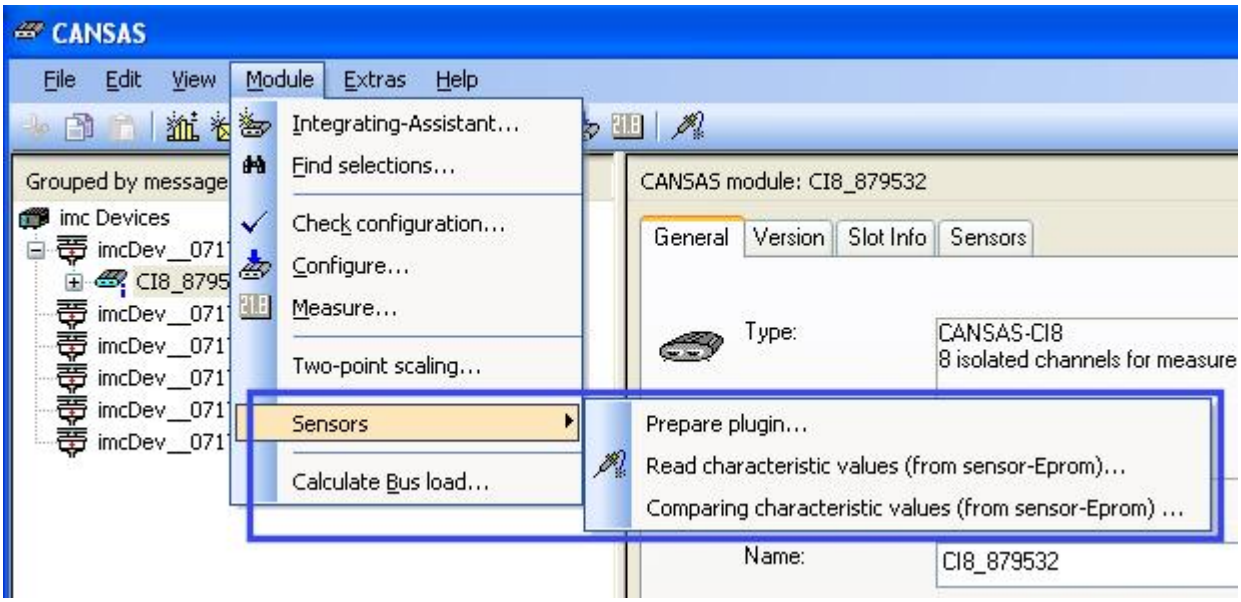


Limitations:

- This function is not available for:
  - Strain-gauge measurement
  - Temperature measurement
- The scaling distance between X1 and X2 must be at least 1/200 of the input range end value

3.4.4.7 Module - Sensors

Under *Sensors* there are three menu functions>



Prepare plugin...

Purpose: This is used to set the selected module's sensor supply voltage to +5 V. Perform this function prior to connecting sensors in order to avoid possible damage to the sensors due to overvoltage.

Read characteristic values (from sensor-Eprom)...

Purpose: Prepare and read sensor identification

Shortcut:

Toolbar:

Comparing characteristic values (from sensor-Eprom)...

Purpose: This indicates whether the sensors connected match those belonging to the module's current configuration.

3.4.4.8 Module - Calculate Bus load

This command can be used to compute the aggregate load of all modules selected.

3.4.5 Extra

3.4.5.1 Extras - Interface

Purpose: Sets up an interface for communication via CAN-Bus between the PC and CANSAS modules.

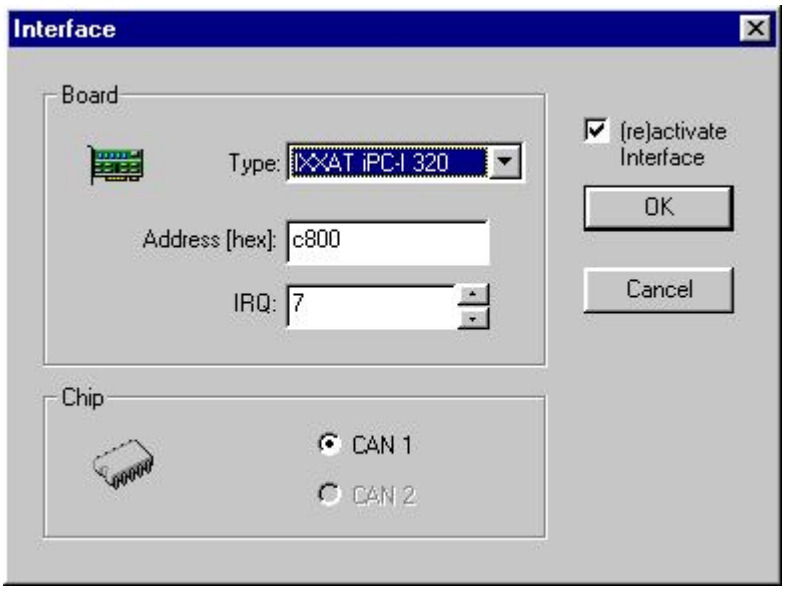
Prerequisites: An interface supported by this program must previously have been correctly installed as hardware using the corresponding board drivers. For this purpose, follow the instructions which come with the board. This product version supports various interface boards from the companies IXXAT, Vector and imc.

- From IXXAT: iPC-I 320 (ISA plug-in board), iPC-I 320/PCI (PCI- plug-in board) and tinCAN PC-Card (PCMCIA).
- From Vector: PC-Card CANCardX (PCMCIA) and CANpari (Parallelport-Dongle).
- imc offers a CAN/USB adapter as an interface.

The program only allows *one* active interface, therefore if multiple interfaces are installed as hardware it is only possible to *alternate* among them; it's not possible to set up several for simultaneous use. In any case, only the respective interface's CAN-Controller 1 is supported. If the interface board has two CAN-Bus terminals, then be sure to connect the CANSAS-module at the correct plug!

The Interface Dialog

The following options allow you to specify which interface to use and how it is configured.



Type: Select from the combo box which interface type is to be used with the PC. PC-Card-Interface (PCMCIA) or PC-plug-in board in the ISA or PCI version.

Address (enabled for Type: ISA plug-in cards): For entering the base address of the I/O-space used by the ISA-board. The setting must be a hexadecimal value in the range C000 to FE00 in steps of 8k. The default value is D000.

The range D000...D1FF is a free area in most Windows systems. Other possibilities would be, for instance, D200, D400 etc. See the documentation for the interface board for more detailed information.

This setting only pertains to ISA-Interface boards. Note: If an IXXAT ISA-card is used by means of the VCI driver software 2.x, the same value must also be used as in the control program *IXXAT Interfaces*. This program can be found in the Control Panel after VCI installation has taken place.

IRQ (enabled for Type: ISA plug-in cards): For entering the number of the IRQ used by the ISA-board. The default value is 7.

IRQ 7 is an interrupt vector which is usually free since it's mostly used by a PC's second printer interface. If this IRQ isn't available, IRQ 5 is to be recommended, which is for the most part only used in Windows-

systems where DOS-Box-supporting sound hardware is installed. This is frequently the case when the sound hardware is PCI-compatible. Since the DOS-supporting property is rarely relevant, it's probably worth sacrificing it for the sake of gaining the use of its interrupt. IRQ 9 is another frequently free interrupt.

The IRQ to select depends upon what PC resources happen to be free. See the interface board documentation for more details on the IRQ settings. The IRQ value entered must match the corresponding jumper configuration of the plug-in board!

This setting only pertains to ISA-Interface boards. Note: If an IXXAT ISA-card is used by means of the VCI driver software 2.x, the same value must also be used as in the control program *IXXAT Interfaces*. This program can be found in the Control Panel after VCI installation has taken place.

Board No. (enabled for Type: PCI plug-in cards): For entering the index of the PCI-version CAN interface board. Possible entries are 0, 1, 2,... etc. The default is 0. Only use a number other than 0 if *more than one* CAN-PCI-board is installed in the PC!

This setting only pertains to PCI-Interface boards.

Slot (enabled for Type: PCMCIA drive): For entering the ID-number of the PCMCIA-slot in which the interface module is ported. The options are 1 and 0, 0 being the default.

This setting only pertains to PC-Card-Interfaces (PCMCIA).

LPT # (enabled for Type: parallel adapter): For entering the number of the PC parallel port terminal into which the adapter is plugged. Possible entries are 1, 2, ...

This setting only pertains to parallel port interfaces.

Automatic detection: When this option is active, the number of the parallel port into which the adapter is plugged is recognized automatically. This renders the previous dialog control obsolete!

This setting pertains only to parallel port interfaces which support automatic LPT recognition (Vector CANpari).

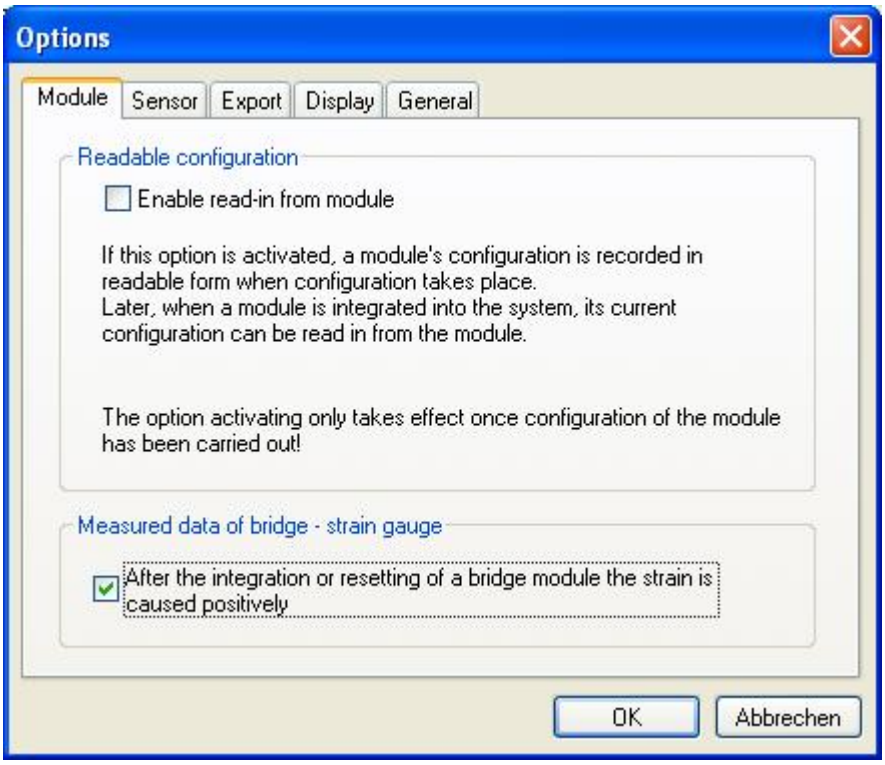
(Re)activate Interface: Specifies whether the interface is to be initialized upon confirmation of the interface settings using the *OK* softkey. A choice of Yes amounts to a check of whether the interface is present and responding properly. If No is chosen, initialization is delayed until accessing of the CANSAS module first becomes necessary.

The initialization process can last a few seconds and is only performed once within a CANSAS session. By calling the *Interface* dialog after the interface has begun to be used and then closing it by pressing the OK softkey without having changed the settings, it is possible to reinitialize the interface if this option is set to Yes. This might come in handy if an unexpected problem ever arises when accessing the bus via the interface.

3.4.5.2 Extras - Options

3.4.5.2.1 Module

Purpose: Settings options affecting the software's general behavior.


Options
Module
Sensor
Export
Display
General
Readable configuration
Enable read-in from module
If this option is activated, a module's configuration is recorded in readable form when configuration takes place.
Later, when a module is integrated into the system, its current configuration can be read in from the module.
The option activating only takes effect once configuration of the module has been carried out!
Measured data of bridge - strain gauge
After the integration or resetting of a bridge module the strain is caused positively
OK
Abbrechen

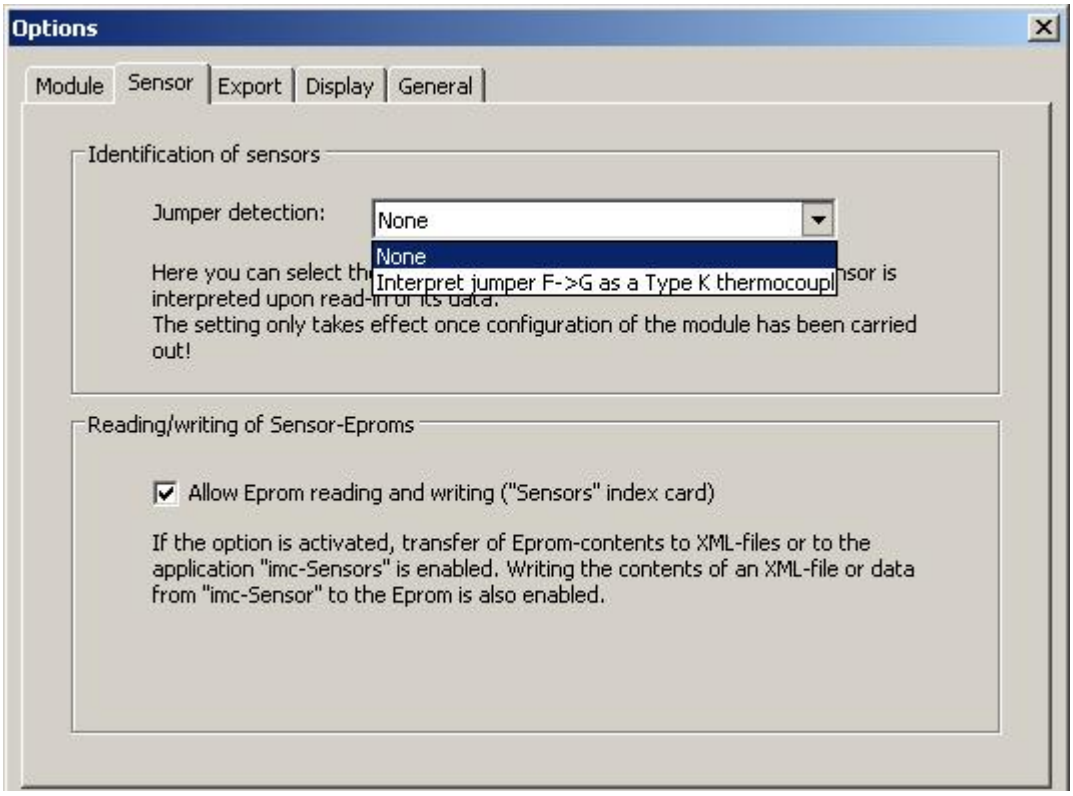
Readable configuration: It is possible to read a configuration into a module in such a way that it can later be read by the software. This makes it possible for a module's configuration to be taken up in the database although it was made on a different PC. See the description for "Readable configuration" below.

Measurement data of bridge - strain gauge: Give positive values for strain. Valid after reset or new integration of a module. → Information to strain gauges 156.

Calibration: Show state of calibration. For further information see here 194.

Firmware-Update: Enforce firmware in case of incompatibility between PC software and firmware of the module. Since CANSAS version 1.6 the handling of the firmware has been changed. This could cause incompatibilties with older versions.

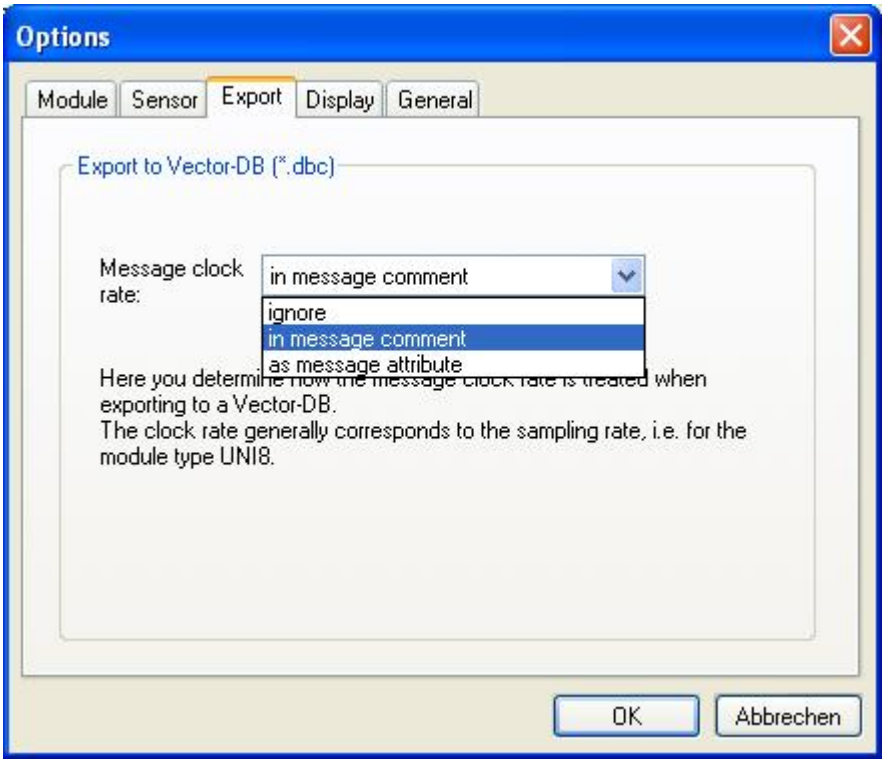
3.4.5.2.2 Sensor


Options
Module
Sensor
Export
Display
General
Identification of sensors
Jumper detection:
None
None
Interpret jumper F->G as a Type K thermocoupl
Here you can select th
nsor is
interpreted upon read-in of its data.
The setting only takes effect once configuration of the module has been carried out!
Reading/writing of Sensor-Eproms
Allow Eprom reading and writing ("Sensors" index card)
If the option is activated, transfer of Eprom-contents to XML-files or to the application "imc-Sensors" is enabled. Writing the contents of an XML-file or data from "imc-Sensor" to the Eprom is also enabled.

Sensor: Identifying data: A jumper from F to G can be used for recognizing Type K thermocouples. Here, the recognition is enabled.

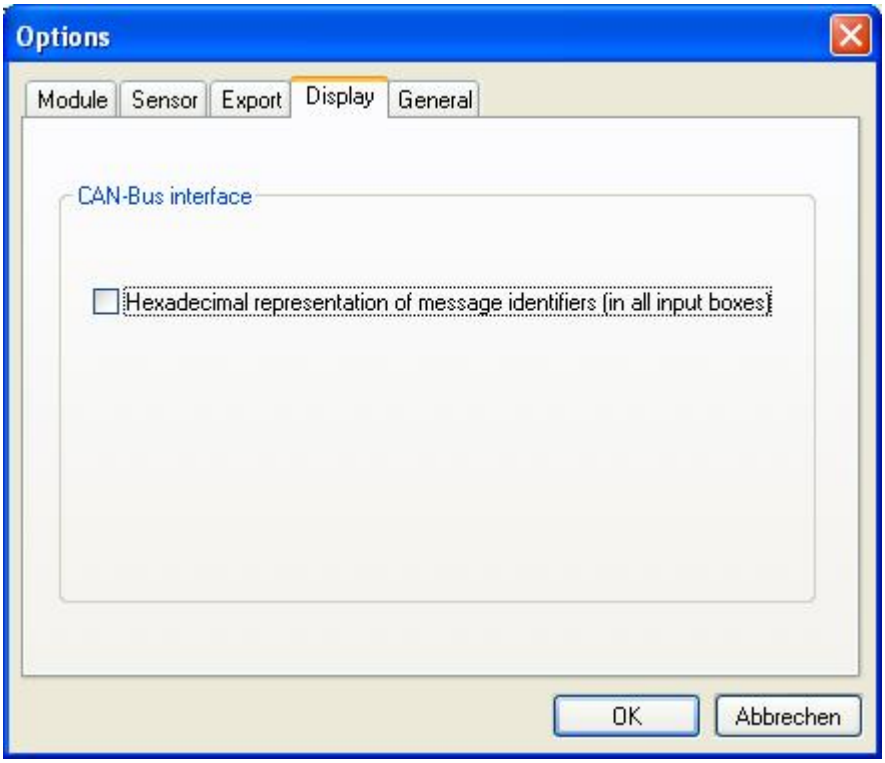
Sensor: Reading/writing of Sensor-Eproms: unless this box is checkmarked, the Sensors page is disabled. Transfer of sensor information from Eproms to XML-files or into imc-Sensors, or importing of XML-file content to Eproms is not possible then. Normal export of sensor information from Eproms is not affected.

3.4.5.2.3 Export



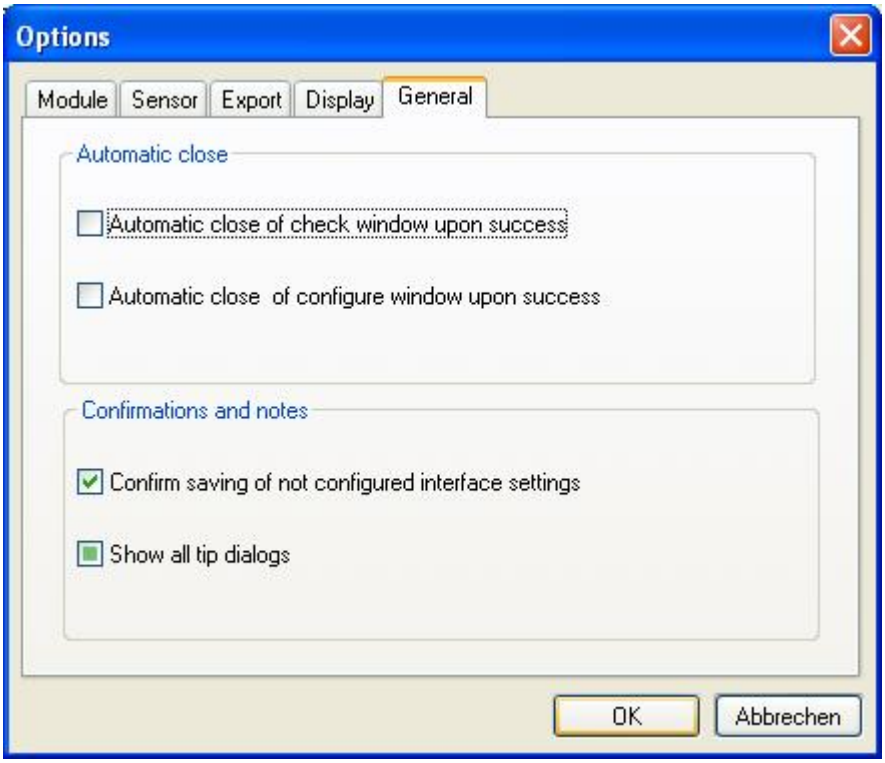
Export: Message pulse rate: Here you set how the message pulse rate responds when exporting a configuration to a Vector database. For instance, for a module of type UNI8, the pulse rate generally corresponds to the sampling rate.

3.4.5.2.4 Display



Display: CAN-Bus-Interface: this option box determines whether the message identifiers in all input boxes are to be expressed in hexadecimal format.

3.4.5.2.5 General



General:

- **Automatic closing:** Options affecting how windows are closed
- **Confirmation:** For confirming a save if the interface settings are not configured. Deactivation of showing all tip dialogs.

3.4.6 Help - Info about CANSAS...

Purpose: This command causes the copyright information and the product version number to be displayed.

Shortcuts

Toolbar:

Remarks: The appearing dialog also indicates the amount of free hard drive memory and free RAM.

3.5 General notes on working with CANSAS modules

3.5.1 MDB database

All information is saved to a MDB database. Availability of this format in the dialog under the menu item *File / Open* is required, and generated when using *File / Save*.

There is an additional possibility to export or import either everything or portions of it in XML format using the menu items *File / Import* and *File / Export*.

Up to CANSAS version 1.6R6 only forward compatibility was guaranteed. Versions as of 1.6R7 are compatible from version 1.6R6 backward.

Modules with absolutely incompatible properties are completely skipped and an associated message is posted upon opening.

3.5.2 Readable configuration

This enables a configuration to be written into a module in such a way that it can later be read out again by the software. This means that a module's configuration can be adopted in the database although it was created using a different PC. See the description of the Options dialog 94.

The feature *Readable configuration* is generally not needed if there is a database containing the current or desired configuration of the CANSAS modules. The feature is needed if modules are configured in one place and later taken to be used somewhere where there's no database. If there is at least CANSAS software where such a model is used, the setting can be read back in order to see how the module is really configured.

Note

- The CANSAS-module property *Readable configuration* is not available to all modules (see features and modules 192).
- If the software version is changed, and thus also the CANSAS firmware, after a configuration had been exported to the PC, then the configuration might not work properly when it is re-imported by the device.
- Error-free re-import is only ensured if one of the following conditions is met: if the CANSAS module is connected via the imc USB interface, or if the CANSAS module is connected via an imc measurement device having a CAN-interface.

3.5.2.1 Readable configuration for µ-CANSAS-HUB4

The determining factor for the arrangement of single-channel µ-CANSAS modules within the messages of a µ-CANSAS-HUB4 module is the ID of the input (IN1,IN2,IN3,IN4) at which the µCANSAS module is connected.

With the readable configuration, the input ID positions within µ-CANSAS-HUB4 module’s messages are saved. The position here refers to the info of whether the first, second, ... module within the message is involved.

Upon reading of the configuration, the information for the modules connected at the inputs is read in the order of their respective positions. For the positioning within the message, the serial number is not relevant. What is decisive is the input at which the µCANSAS module is connected. This means that nonfunctioning µCANSAS modules can be exchanged with other appropriately configured µCANSAS modules without making any new settings.

The exact positions within the messages, however, may change, as illustrated by the following example:

Two messages are configured as readable.

```
Message 1:                              Message 2:
µ-CAN-V1_1 24 Bit (Input 1)             µ-CAN-V1_4 32 Bit (Input 4)
µ-CAN-V1_2 16 Bit (Input 2)
µ-CAN-V1_3 16 Bit (Input 3)
```

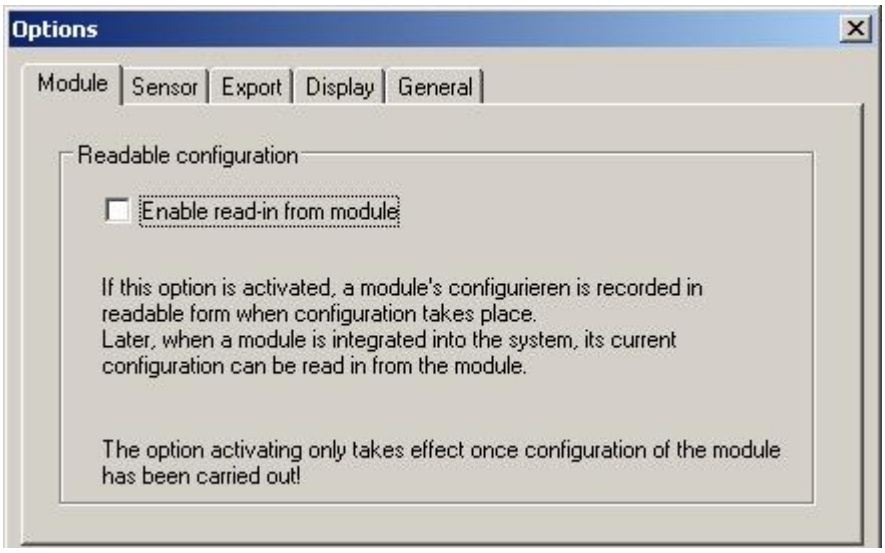
Next, the modules µ-CAN-V1_1 and µ-CAN-V1_4 are exchanged. After reading from the modules, the

following arrangement results:

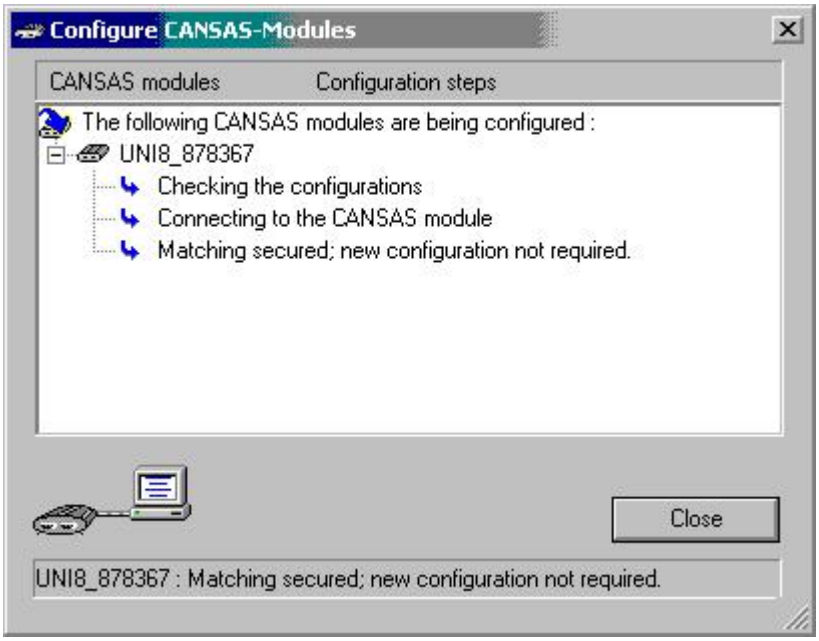
```
Message 1:                              Message 2:

µ-CAN-V1_4 32 Bit (Input 1)             µ-CAN-V1_1 24 Bit (Input 4)
µ-CAN-V1_2 16 Bit (Input 2)
µ-CAN-V1_3 16 Bit (Input 3)
```

3.5.2.2 Operation

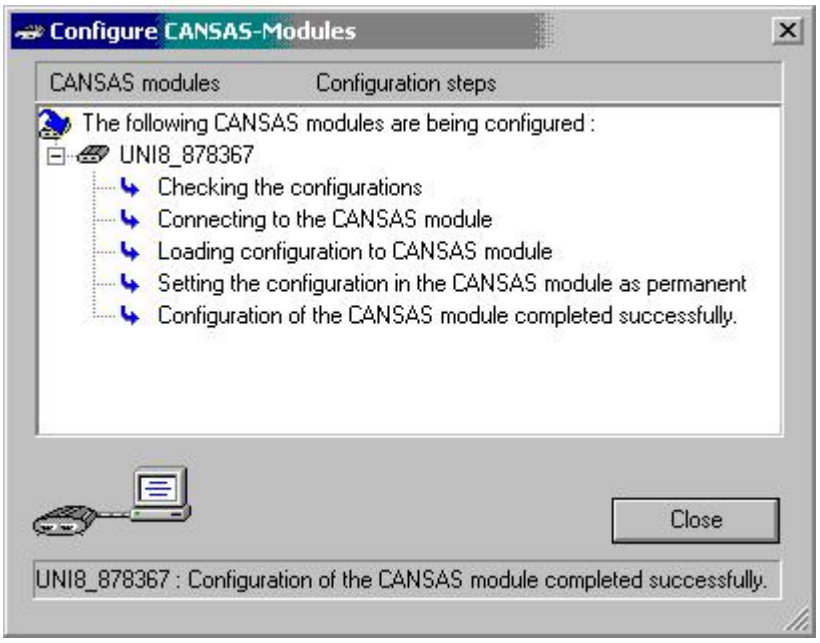
1. The menu item *Extras / Options* calls a dialog, in which you must select the index card *Module*.


Options
Module
Sensor
Export
Display
General
Readable configuration
Enable read-in from module
If this option is activated, a module's configurieren is recorded in readable form when configuration takes place.
Later, when a module is integrated into the system, its current configuration can be read in from the module.
The option activating only takes effect once configuration of the module has been carried out!

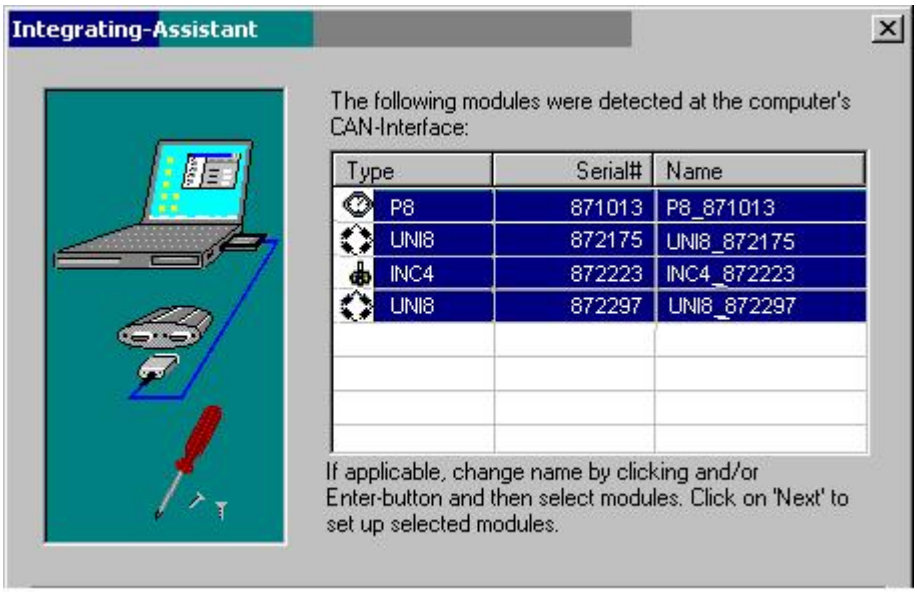
2. Activate the option *Enable read-in from module* and confirm with *OK*.
3. Next, the CANSAS-module is configured.



4. If the CANSAS module's configuration hasn't changed and for this reason the screen shown above is displayed, select the menu item *Module / Configure…* again, while holding down the SHIFT-key. This forces configuration to be carried out:


Configure CANSAS-Modules
CANSAS modules
Configuration steps
The following CANSAS modules are being configured :
UNI8_878367
Checking the configurations
Connecting to the CANSAS module
Loading configuration to CANSAS module
Setting the configuration in the CANSAS module as permanent
Configuration of the CANSAS module completed successfully.
Close
UNI8_878367 : Configuration of the CANSAS module completed successfully.

5. The module is now configured and its configuration is stored in the module in a way which can be read out.
6. You can now save the database.
7. While you work with the database which also contains the configured module, you can see its configuration.
8. Now suppose that you don't yet have this module in the database. For testing purposes you can empty the database, delete all modules or set up a new one. That is the typical situation: the database is empty, you have some CANSAS-modules already configured and want to know their configuration.
9. Now add the new modules using the Integration Assistant.
10. The modules are entered one again into the database, only this time they don't receive the standard configuration, but the configuration read out from the module instead.



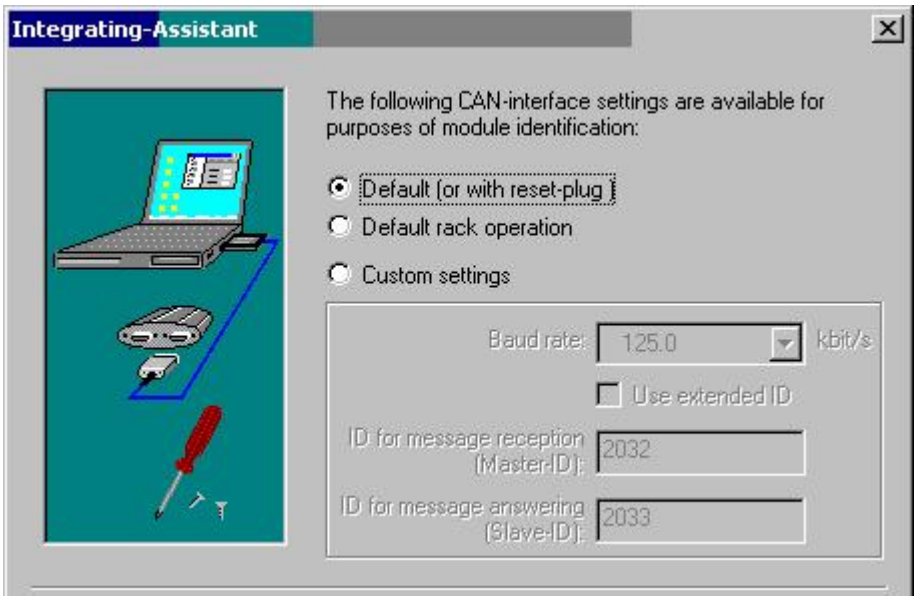
3.5.3 Reset-plug

The Reset-plug comes with the configuration software. It is a 9-pin DSUB-plug in which Pins 3 and 4 are jumpered.

The Reset-plug is used to bring a module with unknown CAN-Bus settings up to a defined Baud-rate so that it is possible to communicate with it.

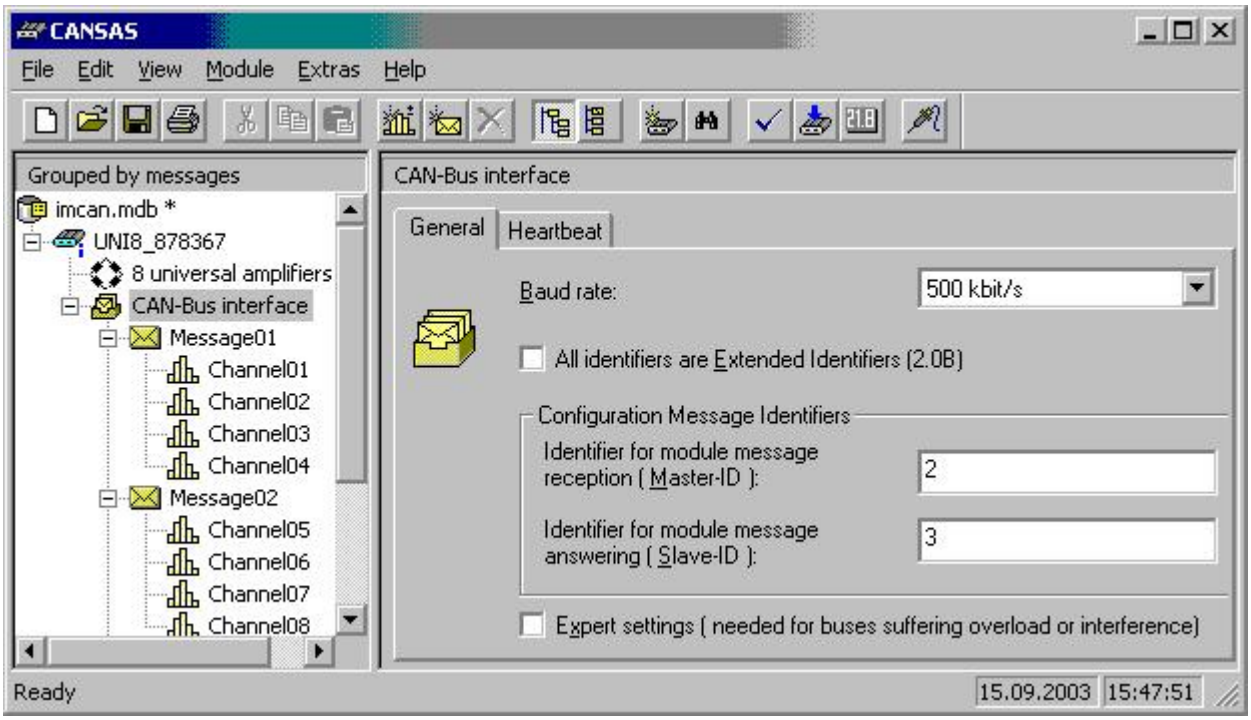
Working with the Reset-plug:

1. Take a single CANSAS-module which you are unable to find on the CAN-Bus using the regular integrating procedure.
2. Disconnect the module's power supply.
3. Attach the Reset-plug to the module. It is inserted into one of the module's two CAN-terminals. Connect the module's other CAN-terminal to the CAN-adapter in the PC via an appropriate short (e.g. 1m..2m) CAN-Bus cable. No other CAN-nodes may be connected. Don't worry if there is no second terminator; the Reset-plug doesn't have any terminator. But for the Baud rate 125kbit/s which is subsequently used, and a short cable, one terminator on the side of the PC's CAN-adapter is enough. This manner of proceeding is of course only permissible as a temporary measure in conjunction with the Reset plug. Otherwise, the CAN-Bus must always be correctly terminated at both ends.
4. Now connect the power supply to the CANSAS-module.
5. The CANSAS-module boots up. You see the LED light up briefly. Then the LED goes off. The module has been reset.
6. The module can now be located as having the Baud rate 125kbit/s, the Master-ID = 2032 , Slave-ID = 2033 and standard identifiers. In the software, access the Integrating-Assistant, select individual integration and then the setting "Default (or with reset plug)".

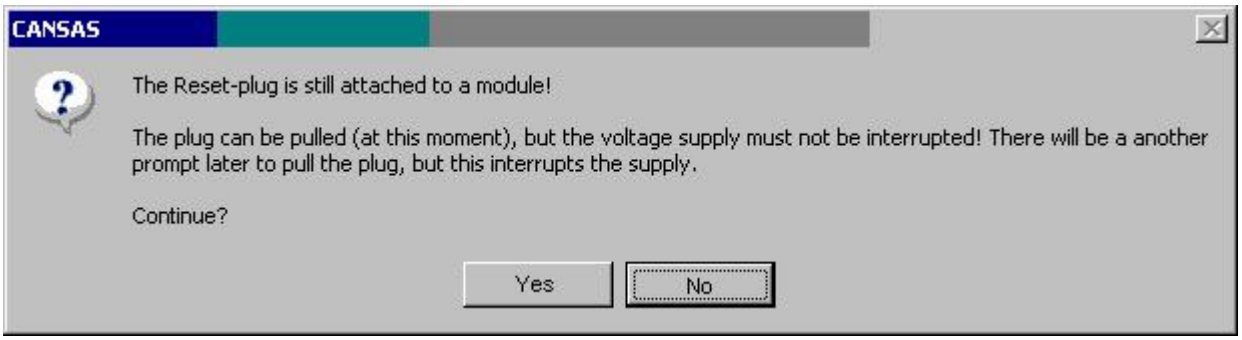


7. Close the Assistant.
8. The module is located and adopted into the software system.
9. The Reset-plug is still connected.

10. Now set the desired CAN-parameters for the module. To do this, select the entry *CAN-Bus-Interface* in the software in the tree at left, and on the right-hand side, select the index card *General*. Then make the following settings, in this example, for rack operation:

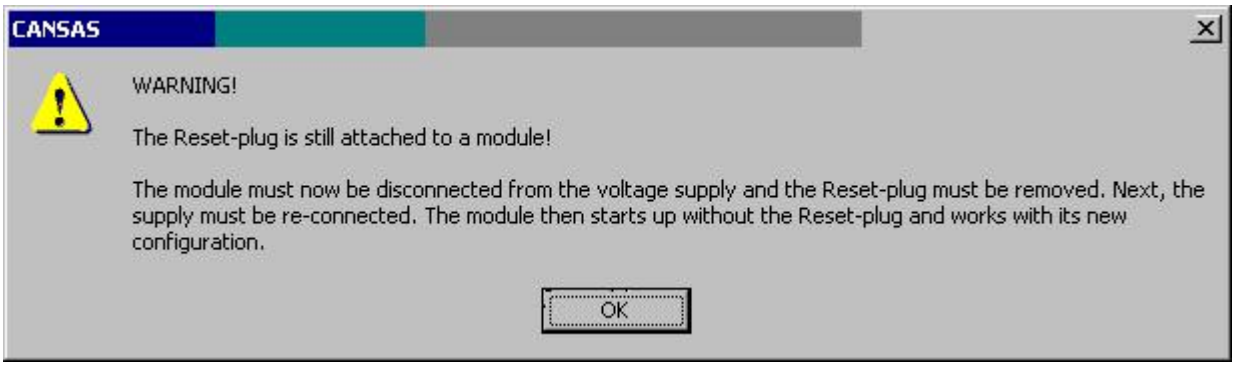


11. Next, the module must be configured. So select it from the menu *Modules /Configure…*


CANSAS
The Reset-plug is still attached to a module!
The plug can be pulled (at this moment), but the voltage supply must not be interrupted! There will be a another prompt later to pull the plug, but this interrupts the supply.
Continue?
Yes
No

12. You can leave the Reset-plug on the module. Confirm with *Yes*.

13. Once configuration has been successfully completed, the final prompt to pull out the Reset-plug appears:


CANSAS
WARNING!
The Reset-plug is still attached to a module!
The module must now be disconnected from the voltage supply and the Reset-plug must be removed. Next, the supply must be re-connected. The module then starts up without the Reset-plug and works with its new configuration.
OK

14. Remove the Reset-plug and re-connect the module to the CAN-Bus. For this purpose, the supply voltage must at least be briefly interrupted so that the module can reboot. Note that this is the moment to re-attach any terminator plug which may have been removed before. The CAN-Bus must be connected to 120Ω at each end.

The Reset-plug is not needed for normal operation. We highly recommend that you always operate all CANSAS-modules, which are used in a single environment, with the same CAN-parameters (i.e. Baud rate, Master-ID, Slave-ID). Then you can combine any modules to CAN-Busses without their interfering with each other.

If you use multiple CANSAS-modules in conjunction, give regard also to the notes on rack operation. There you can find hints especially on the topic of running multiple modules.

☞ **Important notes:**

- Be aware that the module checks whether the Reset-plug is attached upon every cold or warm start. If the Reset-plug is attached, the module starts with the default CAN-parameters. It doesn't start measurement at this point.
- There is no reason to attach the Reset-plug to a module during a running measurement. It will simply be ignored.
- Note that in certain situations the unit starts warm, for example when configuring, making a firmware update, when reading from and writing to sensor- or slot Eproms as well as other cases.
- The module will not take measurements if it is started with the Reset-plug attached. It can only be prepared to take measurements if the Reset-plug is removed. Not only that, it must also be re-activated, for instance by briefly removing its power supply.
- When operating with the Reset-plug, it is recommended to do only as much as is necessary, namely to reset the system to a defined and thus known Baud rate. Afterwards the Reset-plug should be removed right away. Then you can resume work with the module as accustomed.
- If mysterious bus errors repeatedly occur when working with multiple CANSAS-modules (e.g. modules can't be found, configuration takes too long and doesn't always work), this may be caused by one of the following:
  - The CAN-Bus wiring is faulty (e.g. terminators, no branching).
  - The modules have different Baud rates. The CAN-Bus can only work properly if all the bus' nodes have the same Baud rate. Always avoid joining modules with different Baud rates in a CAN-Bus circuit.

3.5.4 Bus-off error - Change baudrate

When configuring the CANSAS modules, their Baud rates must be known. When the CANSAS software is exited, the last Baud rate to have been set is saved along with the database (mdb-file). This ensures that upon any later measurement, the CANSAS hardware and the PC are both using the same Baud rate.

If, however, an older database is loaded, it's possible for the database's Baud rate not to match the one used by CANSAS. A Bus-off error occurs.

Avoid Bus-off errors by observing the following:

- Any change of Baud rate must be made simultaneously for all modules.
- If different mdb-files are used to create the configurations, the same Baud rate must be used absolutely always.
- Whenever possible, a system should only use one single Baud rate value. Even if there are several nodes, the probability of an error is reduced.
- Consider using your option to order your CANSAS unit factory configured with the desired Baud rate.
- Use as the Master ID= 2 and the Slave ID= 3 (as with Standard Racks)

☞ **Note**

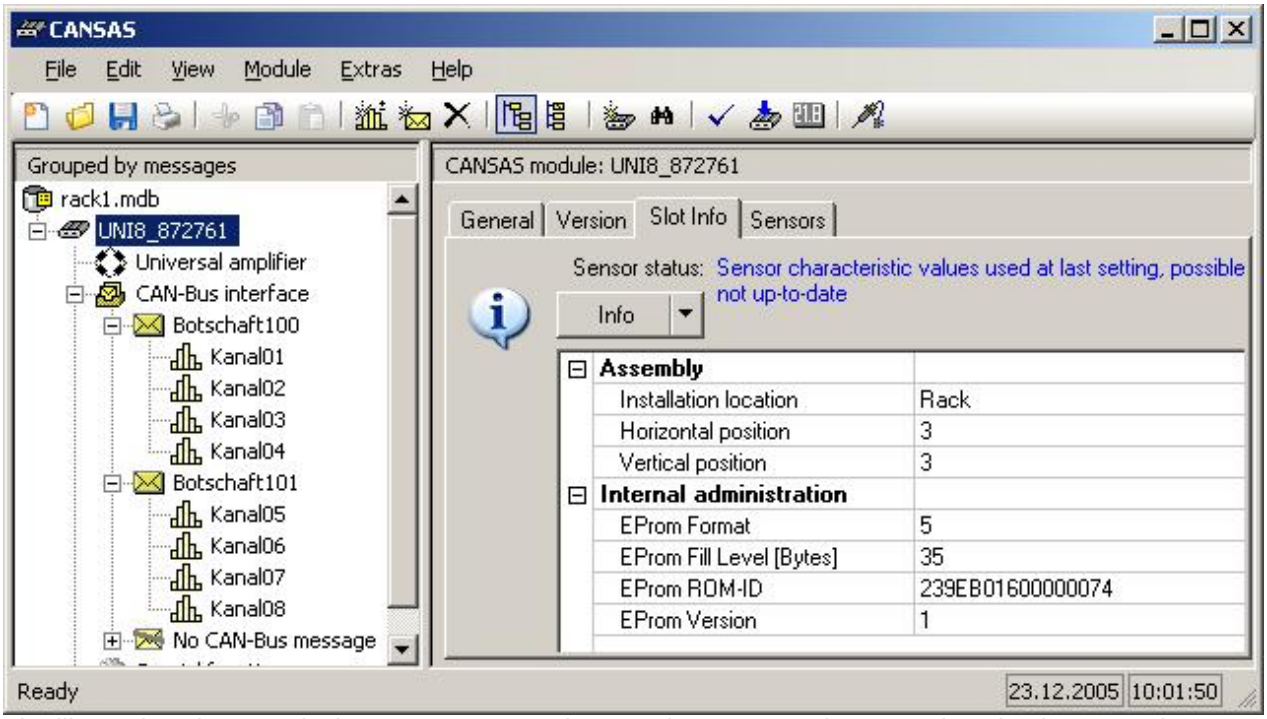
- CANSAS is using the slave ID plus seven following IDs. If ID = 2 and Slave ID = 3, then the IDs 4..10 will also be reserved and can’t be used for other purposes.

3.5.5 Racks

3.5.5.1 Racks, slot identification

In the 19" subracks or module cages produced by imc, there is an Eprom on the subrack's backplane for each slot. If a CANSAS-module is inserted into the slot, it is connected to the power supply, the CAN-Bus and to the slot's Eprom as soon as it docks in. The Eproms are factory-programmed to describe the Positions 1 .. 10 (or another highest position depending on the width of the cage).

The CANSAS operating software can query the contents of this Eprom. To do this, select the module in the tree on the left side of the user interface (the module's base entry), and on the right-hand side, the index card *Slot-Info*. Then hit the *Update* button. The Eprom's contents are read out. Naturally, the module must be connected in order for this to work, and must be in contact with the PC via the CAN-Bus and be inserted into a rack having Eproms.



The illustration shows typical Eprom contents. The actual content can be overwritten by the user. The horizontal position is the slot's position number within the racks, where 1 refers to the leftmost slot.

3.5.5.2 Using CANSAS in a rack

- **Power:** Make sure to provide adequate power and appropriate voltage from the adapter which supplies the rack. We recommend a voltage of at least 24 V so that a small current and thus only moderate voltage drops at the backplane will result.
- **Plugging-in (Hotplug):** While CANSAS-modules are already docked in the rack and measuring, no other modules should be inserted. Modules should always be either inserted into or removed from the rack with the power supply off. However, if it becomes necessary to insert modules during running operation, note that the modules' first contact with the terminal's supply voltage will produce a considerable inrush current. This current can cause a brief collapse of the voltage supply to the other modules, which means that undisturbed operation cannot be ensured in such cases.
- **CAN-plugs:** In the standard rack from imc, each slot has two CAN-Bus plugs. These two plugs are designed so that the inserted CANSAS-module receives the complete CAN-Bus and supply connection. But these plugs are not both equipped as per CiA®. In particular, the CAN-Bus is connected to only one of the two plugs. Only CANSAS modules should be connected at this plug. It is important not to use these plugs to, for instance, attach a Reset-plug or a CAN-Bus cable as a stub line.

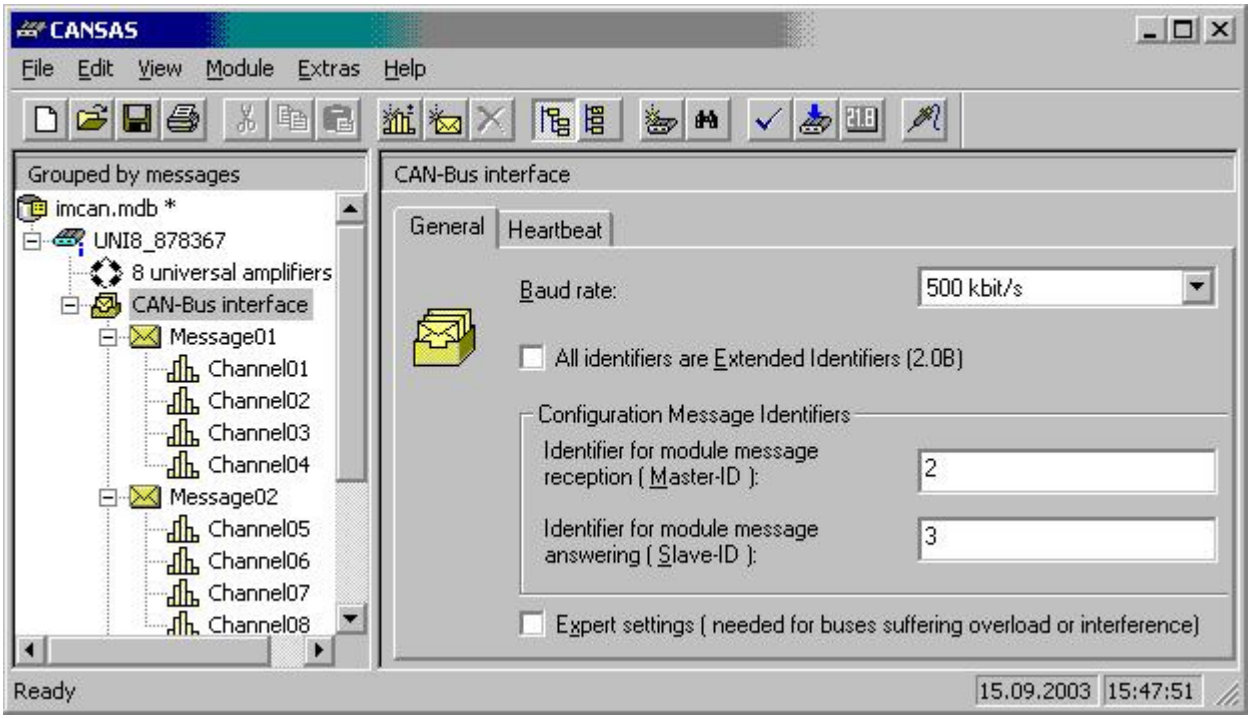
- **Baud rate:** All CANSAS-modules in a rack must have the same Baud rate. If even only one of the modules or the PC is set to a different Baud rate, the CAN-Bus will not work. The CAN-controller components detect a bus-error and deactivate themselves. The CAN-Bus is programmed to do this. It is recommended that you work with only a single Baud rate within the test location or environs for which task the CANSAS-modules are places in the racks. Only then is it possible to freely combine modules, to insert them into racks and to have them automatically recognized by the user interface. The setting Standard- or Extended identifier should also be the same for all.
- **Master / Slave-ID:** Along with the Baud rate, a single Master- and Slave-ID should also be set for all the CANSAS-modules. Like the Baud rate, these two CAN-Bus identifiers absolutely should be the same throughout the measurement setup. The two identifiers enable the user interface to find any CANSAS-modules connected to the CAN-Bus and to make settings for them. When CANSAS-modules are first integrated into the system, always enter these two IDs along with the Baud rate. It is also only possible to find modules in the system with these identifiers. In this case it is desirable and even necessary that the same CAN-identifier is set for all modules. Note that for sending measurement values along the CAN-Bus it's exactly the other way around: in this case, all identifiers absolutely must be different (unique), for the CAN-Bus to operate.
- **Major customers / Factory-set Baud rate:** By default, CANSAS-modules are shipped with a Baud rate of 125k and Master/Slave ID 2032 and 2033. For major customers, the rack-operation alternative is available: Baud rate 500k and ID 2 and 3. This combination is especially recommended for operation in racks. If you are a major customer, arrange with our Sales personnel for all your CANSAS-modules to be pre-configured for rack operation. Then you can immediately employ virgin modules in your rack.

3.5.5.3 Rack maintenance

The rails in the 19“-subrack gradually become worn down and require a certain amount of maintenance. If it becomes difficult to insert or remove modules, then it's possible to lubricate the rails with such substances as Vaseline. Feel free to contact our Customer Service for suggestions.

3.5.5.4 Operating software, modification of the Baud rate

In the operating software, the Baud rate can be set individually for each module. To do this, select in the tree at left the entry *CAN-Bus-Interface*. This entry exists for every CANSAS-module type. On the right-hand side of the screen, select the index card *General*.



Observe the following notes:

- If only a single module is connected to your CAN-Bus (in other words, only the two CAN-nodes PC and 1 CANSAS-module), then you can change the Baud rate and other settings as you wish and then configure the module. Once the module has been configured successfully, the CANSAS-module reboots and starts up with the new Baud rate. The PC also switches to the new Baud rate. You can then communicate with the module with this new Baud rate.
- If you use a CAN-Bus with multiple subscribers, they must all always have the same Baud rate. If even one subscriber has a different Baud rate, the CAN-Bus no longer works. The CAN-controllers detect bus errors and deactivate automatically; the CAN-Bus is designed to do so. If you wish to change the Baud rate for the entire CAN-Bus, this must be done for all subscribers at the same time.
- If you use the CAN-Bus just with the PC and otherwise only CANSAS-modules, the Baud rate can be changed for all subscribers at once. First set the new Baud rate for all modules in the user interface. The select all modules in the tree on the left side of the user interface. Then select the menu item *Modules / Configure...* The software recognizes that the Baud rate is to be changed, notifies all modules of the new Baud rate and has them all reboot at the same time. They all then boot up with the new Baud rate.
- The technique described above only works if all the modules already had a common Baud rate, so that it was even possible to address them all via the CAN-Bus. This technique is only available from the firmware for the software version V1.3Rev.11 onwards. If this isn't present, first configure the modules without changing the Baud rate in order to update the firmware.
- If you use other devices with your CAN-Bus (besides CANSAS-modules), changing the Baud rate is more difficult since these devices don't respond to the CANSAS software's boot command. In this case, these devices must be first removed from the CAN-Bus and changed separately. Afterwards they can be re-integrated into the system.
- If it ever does occur that modules with different Baud rates are joined in a common CAN-Bus, there will constantly be bus errors. CANSAS-modules will either not always show up during searches or not at all, or configuration fails etc. The symptoms are the same as for a physically defective bus, e.g., due to a line which is too long, or if there is too much interference or incorrect termination (e.g. the 120 Ω resistors needed at both ends of the CAN-line are missing). If you are certain that the trouble is caused by different module Baud rates, you can remove the offending modules from the system and set them to the correct Baud rate separately. Alternatively, you can use the Reset-plug.

There are two ways to do this:

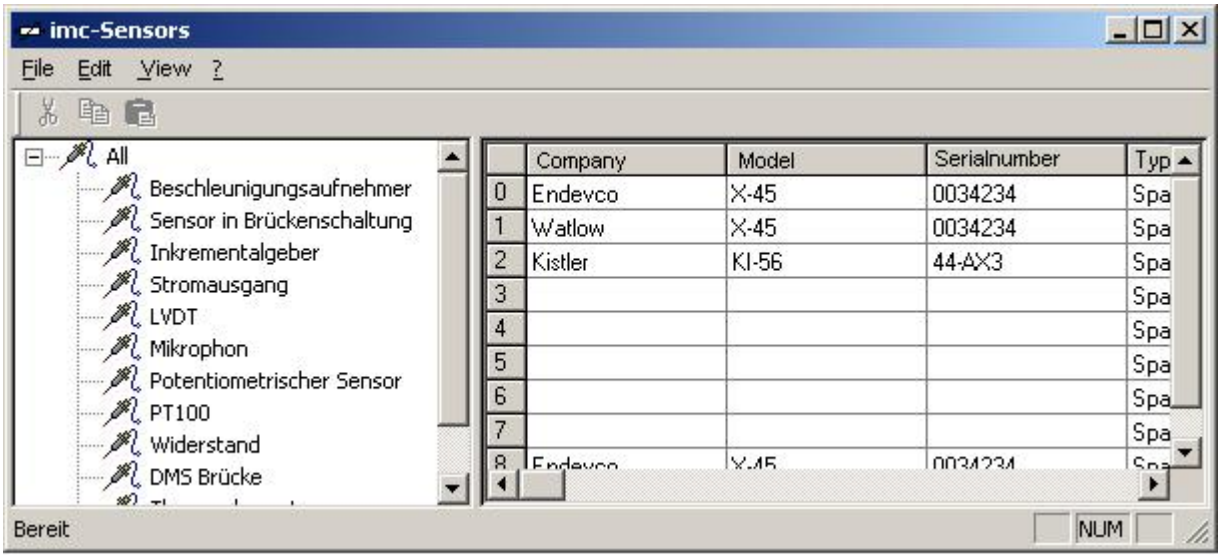
a. The Reset-plug is inserted in every CANSAS-module.
b. A CAN-cable is used, to which Pins 3 and 4 of the 9-pin DSUB-plug are connected. In this case, a Reset-plug on one module is sufficient.

The point of the Reset-plug is that Pins 3 and 4 are jumpered. If a module detects this short circuit upon activation of its power supply, it starts with the standard Baud rate of 125 kbit/s. You can then find all modules at once in the integrating process, set the new Baud rate for them and then configure them.

3.5.6 Connecting to "imc-Sensors"

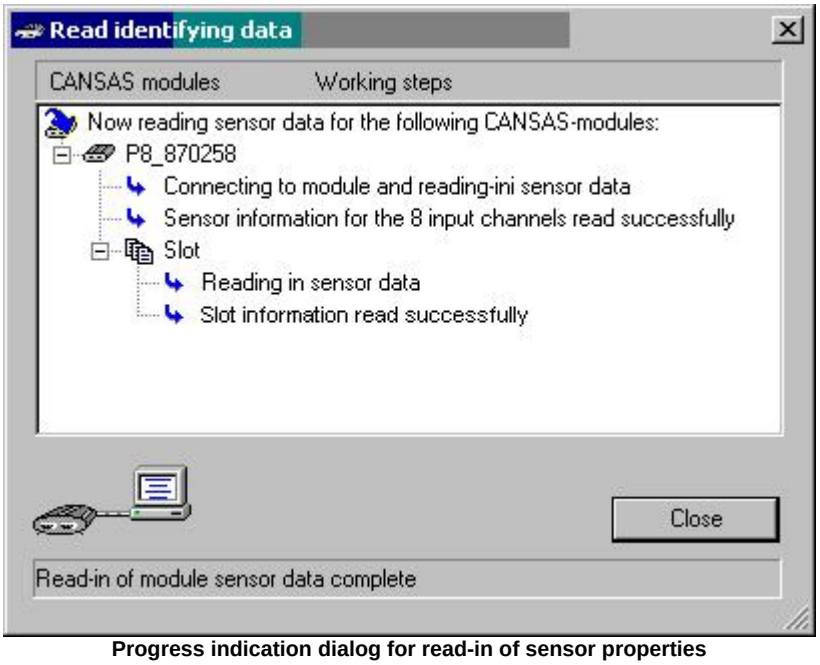
The sensor database imc-Sensors is a separate product and not an element of the CANSAS software. But the two programs work seamlessly in concert. Please refer also to the user's manual for the imc-Sensors software.

Start: imc-Sensors can be started from CANSAS using the menu item *Edit/ Start imc-Sensors*. This menu item is only enabled if imc-Sensors is installed and not yet started.



Transferring sensor properties: In the imc-Sensors user interface, select the sensor which is connected or to be connected. Use the Drag & Drop technique to move it to the corresponding channel's entry in the tree diagram of the CANSAS user interface. There, the target will be displayed as selected.

Once you have "dropped" the sensor, a dialog appears showing how the sensor settings were applied in the channel. Any error messages will also appear.


Read identifying data
CANSAS modules
Working steps
Now reading sensor data for the following CANSAS-modules:
P8_870258
Connecting to module and reading-ini sensor data
Sensor information for the 8 input channels read successfully
Slot
Reading in sensor data
Slot information read successfully
Close
Read-in of module sensor data complete

Progress indication dialog for read-in of sensor properties

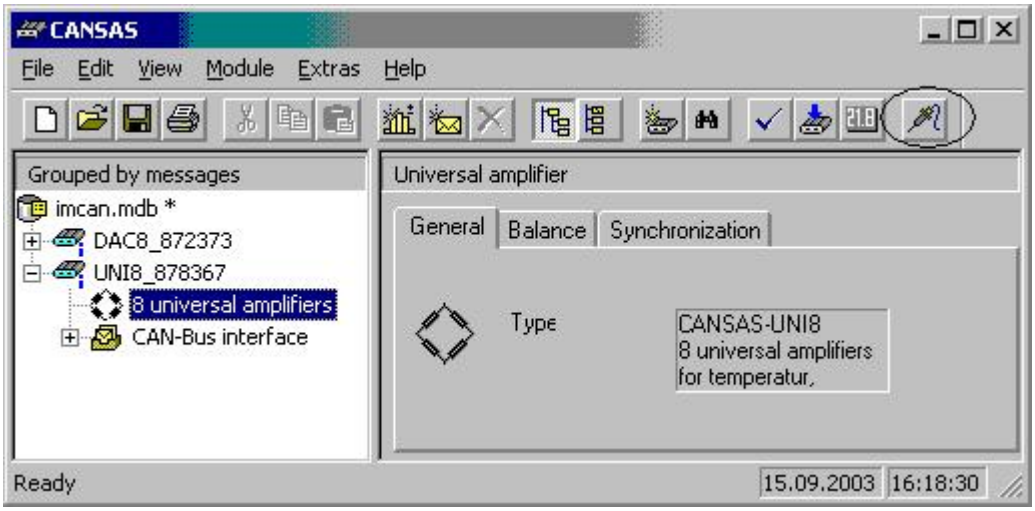
There is an alternative to the Drag & Drop procedure, in which you also first select the sensor in imc-Sensors. Next, select one or more channels in the tree diagram on the left side of the CANSAS user interface and the menu item *Edit / Add sensor...*. Then the sensors properties will be used for setting all the selected channels. This makes sense for sensor properties common to many units, independent of any serial number; for instance, a simple Type K thermocouple.

3.5.7 Sensor recognition

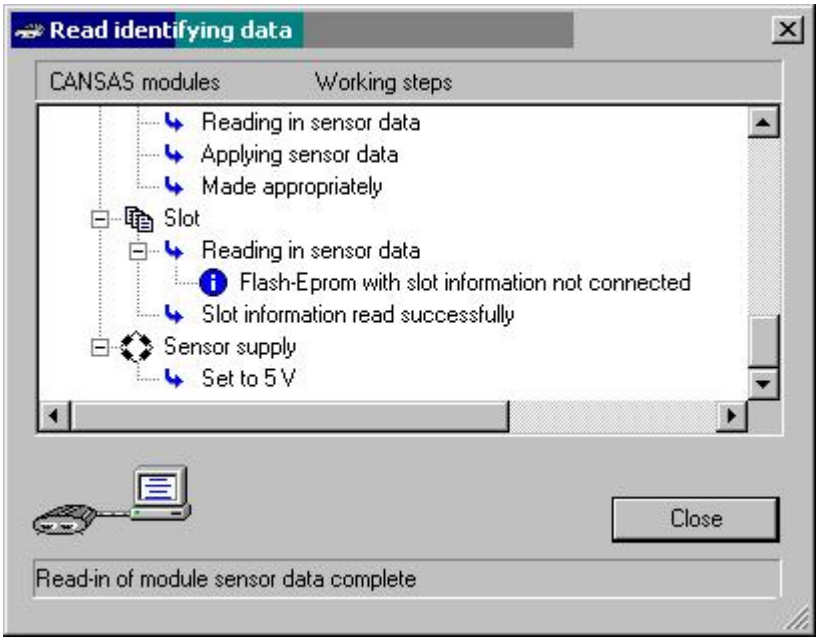
Some CANSAS-modules such as UNI8 are able to read-in sensors with Eprom. These are intelligent sensors in which an electronic spec sheet is stored in the Eprom. This spec sheet is also referred to as TEDS (Transducer Electronic Data Sheet), as described in the industrial standard IEEE 1451. The standard IEEE 1451.4 is of particular interest in this context. At this writing, however, this standard is as yet at the "proposed" stage, therefore not yet official. The electronic spec sheet contains information for administrating it, such as its manufacturer, model and serial number. Also data for scaling, such as sensitivity, and physical and electrical value range. And finally, it also contains data on the sensor's power supply and calibration.

Sensor recognition, for example in UNI8, proceeds according to the following pattern:

1. Before connecting sensors to the module, you must guard against any danger. For this purpose, you must keep in mind that UNI8 is an all-purpose module with built-in sensor feed. If this internal voltage source supplies 24 V, for instance, because a sensor needing this voltage either is or was connected, no sensor may be connected which can take, for example, only 5 V. The module must first be put in a "neutral" state. To do this use the menu item *Module / Sensors / Prepare plugin...* Then the UNI8 can be configured for a sensor feed of 5 V.
2. Connect the sensors to UNI8. The UNI8 should not be activated at the time. But note any peculiarities of the sensor used. Many sensors may actually be connected while the power supply for UNI8 is on; this is a so-called hot-plug procedure. At this point, the UNI8 (if activated), is not yet correctly configured.
3. Now it is possible to read out the Eprom-chip's sensor information. To do this, go to the tree diagram on the left-hand side of the user interface and there select the entry of the module whose connected sensors are to be read in. Then select the menu item *Module / Sensors / Read identifier data...* Alternatively, the corresponding toolbar button can also be used:



4. Next, a dialog showing the details of which channels are connected to sensors with Eprom appears. It also shows how the sensor properties are transferred to channels settings.



5. Then you can check the suggested settings for the measurement channels and also the global module settings such as sensor feed, and modify them if desired. In particular, check the data rate and channel names.

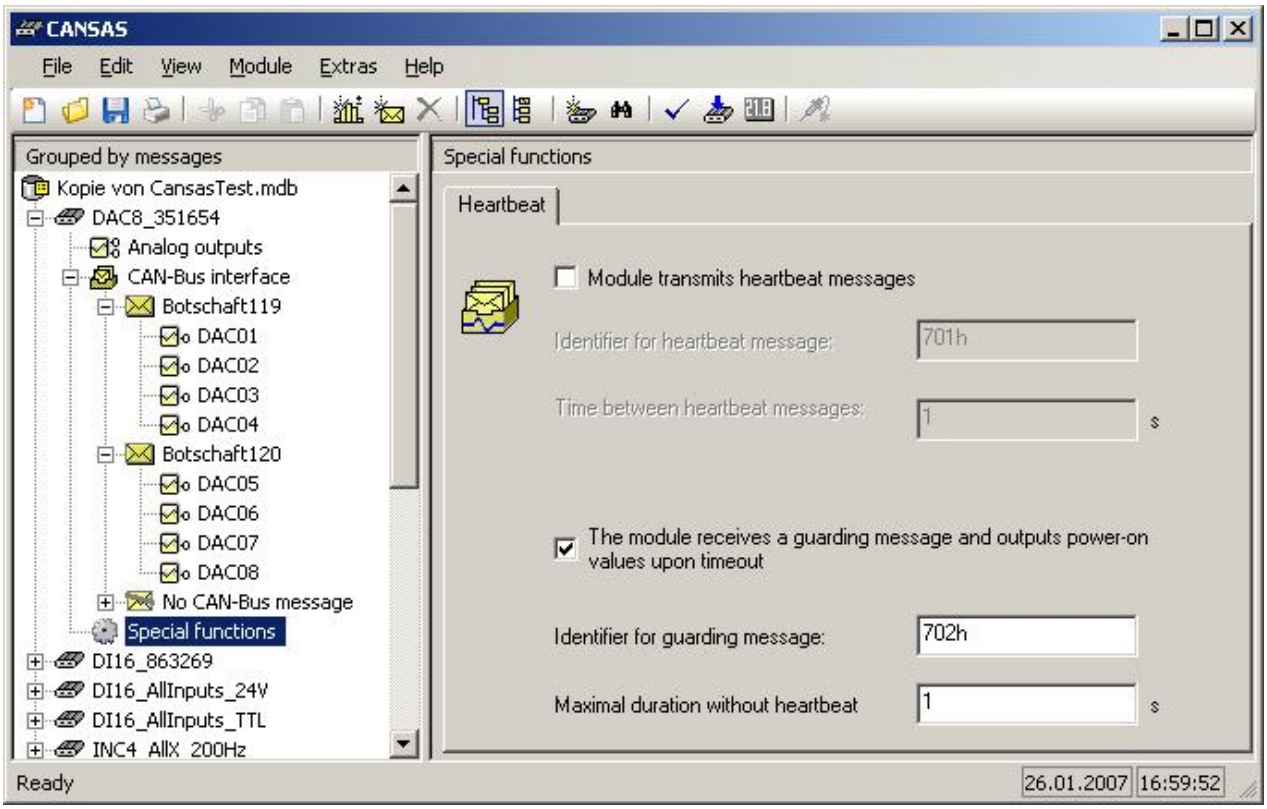
6. Finally, the module must be configured for these settings to take effect.

Checking the connected sensors: Whenever it boots (start, cold-start or warm-start), UNI8 performs a check of the connected sensors. Of course, it is actually the Eprom of a connected sensor which is checked and not really the sensor itself. If the Eprom is the same as when configuration was performed (download or configuration), then it is assumed that the correct sensors are connected. The LED displays the appropriate blink-code (in default configuration). If the Eproms don't match up, a different blink-code is displayed.

3.5.8 Guarding

Guarding is in CANSAS the reverse of heartbeats. This functionality is available only to the CANSAS output modules such as DAC8: a Master such as a process monitoring or automation system sends a cyclical message via the CAN-Bus. The CANSAS module monitors this signal. If the message fails, the CANSAS unit goes into a defined rest state, e.g. zero Volts at the output. This functionality is useful for securing operation of an installation where disturbance of the CAN-transmission or outage of the guidance system must be expected. It is recommended to have the guarding-message emitted at a rate of 1s, for example. Then in CANSAS, a monitoring interval (time-out) of twice that length is set. If the guarding-message fails for longer than that, in our example, for 2 seconds, so that CANSAS misses the message for that time, then all of the module's inputs go into a pre-determined rest state.

The guarding-message is set in the user interface by selecting the entry *Special functions* in the tree at the left, and the index card *Heartbeat* at the right.



There, select the identifier for the message. This identifier must be unique for each module, just like every identifier on the CAN-Bus in general. You can also specify the maximum interval which may elapse until the next time the CANSAS module receives this message. If this interval elapses and the message doesn't arrive, all of the CANSAS outputs go into their rest state.

If CAN-messages setting the output values finally do arrive, the module obeys as usual.

The guarding-message's content doesn't matter. The CANSAS-module only responds to its presence.

3.5.9 Heartbeats

All CANSAS-modules (excepting µ-CANSAS modules and µ-CANSAS-HUB4) can be made to transmit a so-called heartbeat message via the CAN-Bus. This message is basically a sign of life from the module. Just like an animal's pulse proceeds at a regular pace, this type of message works the same way. A master which monitors the entire CAN-Bus can thus determine on the basis of the regularly transmitted message whether a module is still alive (meaning: at least working well enough to send this message).

It is thus seen that this heartbeat message is mainly useful for output modules which don't send messages on their own but rather wait to first receive other messages from the CAN-Bus. Such modules include the DAC8 (analog outputs), the DO16 (digital outputs) or the DO16R (relay) or the PWM8 module (pulse-width modulated output). Without the heartbeat message, the bus master would hardly or only indirectly be able to recognize whether the modules are working at all.

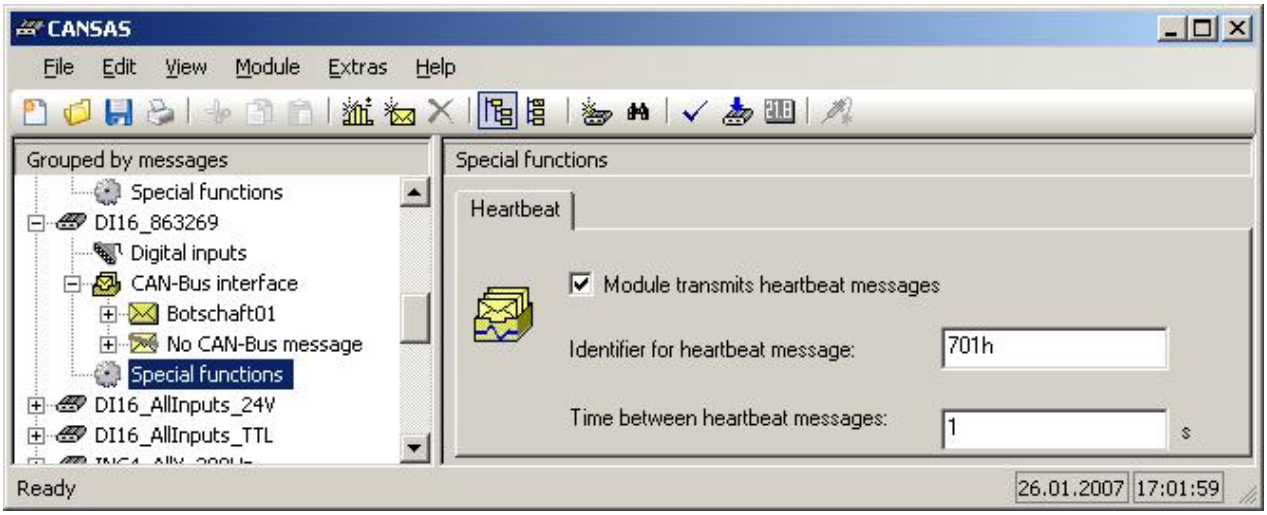
Such a master exists in many situations, e.g., a test rig PC, which controls the overall test station, a guidance system or an automation system.

But the emission of heartbeats is also useful for modules which actually send their measurement data at regular intervals as CAN-messages via the CAN-Bus. The heartbeat message contains important information: The module's serial number and a 'Magic number' for its configuration. and additionally, in the case of sensor-detecting modules such as UN8, a bit which reflects whether the correct sensors are connected. On the basis of this number, the guidance system can determine the following:

- Is the correct CANSAS unit installed? Or could someone have removed and replaced it with a different one, which either is or isn't configured the same way? An experiment setup's record may include info on the measurement equipment used and its calibration. If the device was exchanged, this info would be missing. This situation can at least be detected.
- Is the module configured as it is supposed to be? Naturally, the data-recording measurement system must be able to rely on the CANSAS module being configured as it should be. Otherwise, acquired data may be interpreted incorrectly. If the CANSAS-module was reconfigured, it's at least possible to detect.
- In the case of sensor-recognizing modules it is even possible to notice whether the correct sensors are connected.

All this information isn't directly relevant to conducting a single, classical lab experiment. But at test stations where different personnel set up and conduct a variety of measurements, it can be crucial.

The heartbeat-message is set in the user interface by selecting the entry *Special functions* in the tree at left, and going to the *Heartbeat* index card on the right-hand side.



There, select the identifier for the message. This identifier must be unique for each module, just like every identifier on the CAN-Bus in general. It is also possible to specify the interval at which the message is sent. Intervals in the range between 1s and 10s would be sensible.

Contents of a Heartbeat-message (64 Bit)

Bit 1 … 30	serial number of the module (30 Bit)
Bit 31	reserved
Bit 32	1, if the module is in sync mode; 0 else
Bit 33 … 64	configuration number of the module (32 Bit)

3.5.10 Synchronization

With many CANSAS acquisition modules (modules which measure physical quantities and send CAN-messages), there is the option to synchronize the data sampling of multiple modules.

Example: Each of a UNI8 module's channels is equipped with its own amplifier and A/D converter. All of the module's channels are sampled simultaneously. However, if multiple UNI8 units are used, note that each one has its own independent quartz timer. Therefore, the modules are not synchronized to each other unless special steps are taken. If an application requires synchronized capture on more than 8 channels, the *Synchronization* feature can be used.

In CANSAS, synchronization can be achieved in a variety of ways.

- **CAN-1 Protocol:** A CAN-Bus message is used for the synchronization. This message is sent at a 1s pulse rate by a CANSAS-module acting as the Master. Other CANSAS-modules acting as slaves receive this message and synchronize themselves to it. The message is formatted according to the "CAN-1" protocol. In case devices as *busDAQ* and *imc CRONOS-PL* are used as CAN logger, they should be set as CAN-1 Masters. This is the recommended option whenever these devices also capture the measured data.

  The condition for being able to perform synchronization via the CAN-Bus is that all the devices (both the master and all slaves) are connected to the same CAN-Bus line, and no gateway or router may be connected between them. In the CAN-1 protocol, special care is taken to provide high time-precision.

☞ **Note**

If the CANSAS modules are configured by an imc device CAN interface through imcDevices software, only the imc device is allowed to be set as CAN-1 master.

- **TTL square 1s:** A line is laid between the CANSAS-modules on which communication by TTL-level takes place. One of the CANSAS-modules is declared the Master and generates a 1 Hz square-wave signal. Other CANSAS-modules are declared slaves. They respond to the signal by getting into synchronization. The square-wave signal can also be generated by an external generator. In all CANSAS-modules, one pin each in the CAN-Bus sockets is provided for the TTL-signal. The signal's reference ground is the CAN-Bus ground which also has a terminal in the connector. This arrangement enables the synchronization signal to be efficiently transferred along the CAN-cable.
- **DCF77:** This mode works like the square mode (also a 1 Hz TTL-level signal). But here, the square-wave signal conforms to the DCF77 standard. This means that it also contains the time and date information, which produces a gap in the 59th second of every minute. CANSAS has no use for the time/date information and uses the signal like an ordinary square-wave. CANSAS itself cannot be a DCF-master. For synchronization purposes, it can only play the role of slave.

For all synchronized operating data, a time accuracy of 100µs or better is ensured if the communication between the master and slaves is working properly. Typically, the offset is even an order of magnitude smaller, about 10µs.

All CANSAS units configured as slaves for synchronization purposes are soon synchronized (after approx. 2s) upon startup of a master. Internally, they work with a PLL which already begins to operate at the specified accuracy within a very short time.

Limitations

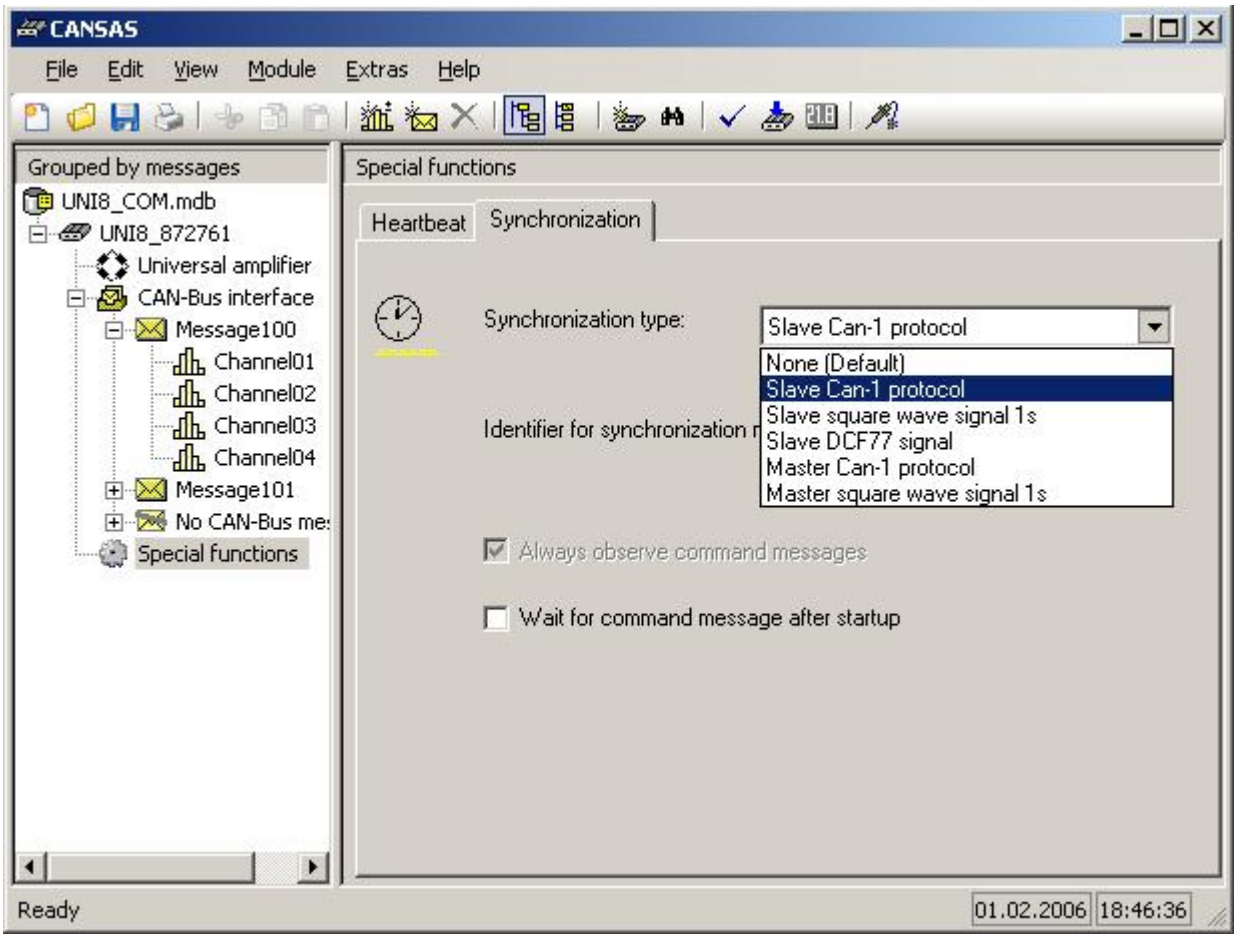
- In case a imc device (e.g. busDAQ-2, -X or busLOG) is operated in sleep/resume mode, synchronization after resume is not possible.
- Please note, that different filter settings cause different delays as well.

CANSAS as Master: If CANSAS is configured as Master for synchronization purposes, note the following: In the CAN-1 protocol, the Master stops all slaves after booting. Then comes a phase during which the module flashes yellow and red for 5s (this applies to all operating types) and does not yet measure. Then measurement starts. If there are slaves, they begin to measure at the same time. The purpose of this starting procedure is that different CANSAS-modules within a system can be activated simultaneously but need different amounts of time to boot.

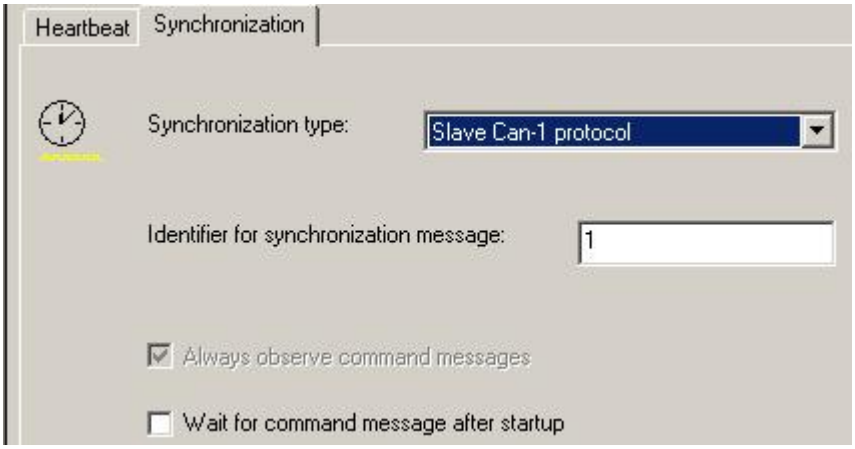
CANSAS as Slave: After booting, a slave waits for a signal from the master. If there is no master to send a synchronization signal, the slave doesn't start. Once the master does become active, the slave starts at the same time. If the master has an outage, the slave continues to work anyway. Of course, if that happens, it cannot really operate synchronously, but it does continue to measure at the same quartz-controlled pulse rate which it last had. If during such a situation a master suddenly is activated, what happened next depends on whether or not the master is (approximately) in the same beat as the slaves (and, in particular, shares the same phasing). If yes, the slave gradually adapts itself to the master's phase, which can take a few minutes. If not, the slave is totally re-synchronized. Towards this end, measurement is briefly interrupted and later re-started. In CAN-1 protocol, the newly-started master would stop all slaves anyway in order to start them simultaneously afterwards.

Setup:

Select Special function in the tree diagram at left. On the right side, select the index card *Synchronization*, in which you set the synchronization type. The default is *No synchronization*. The module can be set either as a master or slave for synchronization purposes, as desired. This is also where to set whether to use the TTL-signal (1s square-wave) or the CAN-1 protocol for synchronizing via the CAN-Bus.



If the CAN-1 protocol is used, the CAN-Bus identifier of a CAN-Bus message must be specified. This identifier should get high priority. The smaller the identifier, the higher its priority, e.g., 1. It isn't necessary for this message to have the highest priority, but it should be relatively high. Note that the identifiers which may be used for recognizing the CANSAS-modules (e.g. 2, 3 and 8 etc.) may not be the same as the identifier for synchronization.



There are also additional options:

- Always observe command messages: The messages are defined in the framework of the CAN-1 protocol. They enable the starting and stopping of measurements.
- Wait for command message after setup: If this is selected, the CANSAS module doesn't start the measurement right after booting. Instead it waits for a message which expresses the command *Start measurement*. These messages are also defined by the CAN-1 protocol.
- For these two options, the ID of the CAN-Bus message to be used must also be defined.

Time offset (Module type, Sampling frequency):

There is a slight time offset between a module's individual channels. This also applies to channels which are equipped with simultaneous Sample And Hold or in which the AD converters work simultaneously. This is because the individually conditioned channels possess analog components such as amplifiers and filters. These have narrow tolerances, but also slight deviations in their frequency response and thus also in the times for signal propagation through the components. However, in UNI8, for instance, these discrepancies are typically around 10µs.

Synchronization really only ensures that the instant in which a sample is taken is the same. But the signal propagation time through the module depends on many factors. These include the analog part with its anti-aliasing filter and any digital filters it may have. The filters (and the digital filters in general) are configured according to the sampling rate. This is because an anti-aliasing filter is selected which is appropriate for the sampling rate set. Thus, the signal propagation time varies with the sampling rate. Although this signal propagation time is constant for a given module type and a given sampling rate, if either of these factors change, so does the propagation time, which becomes noticeable when working with a variety of module types (e.g. UNI8 and P8). This offset is constant and can be corrected but it isn't zero. To simplify matters, it's recommended to use only one module type for real phase or propagation time measurements, and to set the same sampling rate for all measurement channels whose values are to be compared with each other.

Data acquisition:

When CANSAS-modules work synchronously, this makes certain demands on the data acquisition system. In general, it's necessary for the data acquisition system and the master (timer) of all the CANSAS-units to be one and the same device. For an ideal match, use such devices as *busDAQ* and *imc CRONOS-PL*. One such unit can then serve as the master, configured as per the CAN-1 protocol, and the CANSAS-modules act as the slaves.

Virtual Channels

4.1 What are virtual channels?

The CANSAS-module comes with a fixed number of physical channels whose signals can be transmitted along the CAN-bus. However, additional, so-called virtual channels can be generated. These can be data streams computed from a physical channel's signal (e.g. the low-pass filtering of a physical channel). But virtual channels can also be completely artificial constructions (e.g. a sawtooth signal). Also, virtual channels can be used to achieve data compression.

Virtual channels are generally used to pre-process CANSAS-module data. For instance, passing huge amounts of data coming into CANSAS at a high sampling rate straight into the CANbus would severely strain its capacities. The data can be pre-processed while still in the CANSAS system (e.g. in the form of averaging, filtering and subsequent data compression). Consequently, the data load transferred to the CAN-bus can be reduced; only such data are sent to the CAN-bus as are necessary for evaluation purposes.

4.2 Creating virtual channels

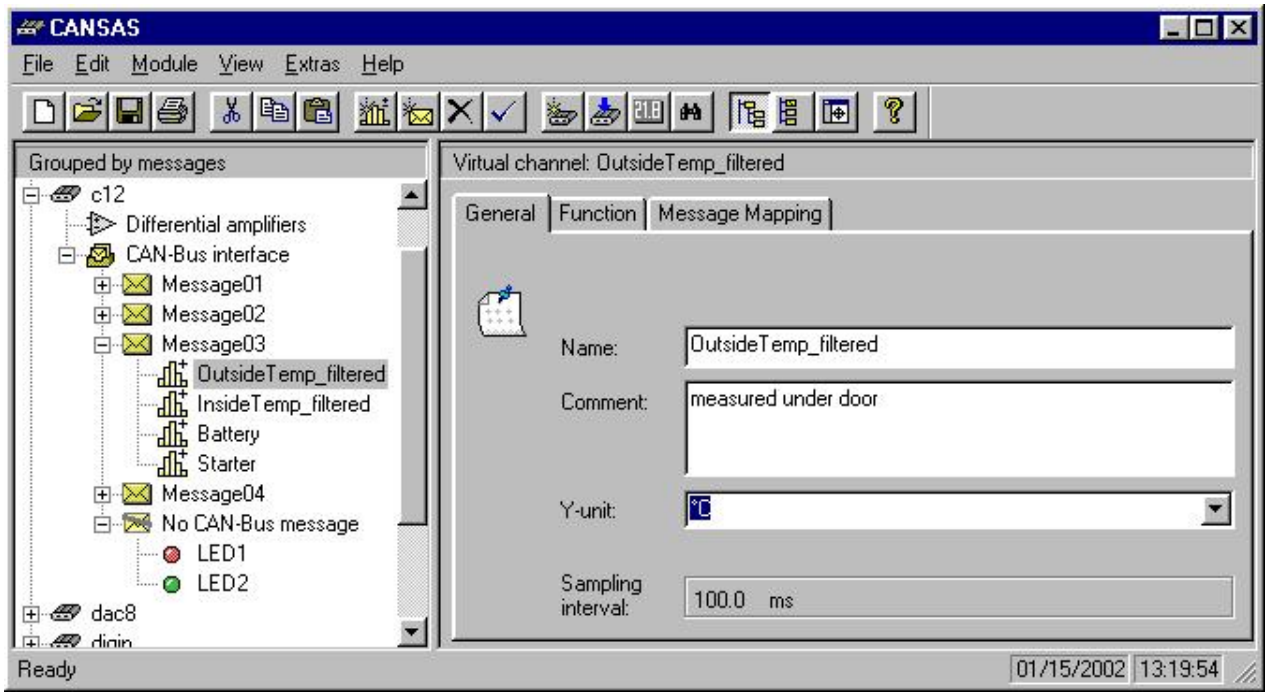
To establish a virtual channel, use the command 'New/ Virtual channel' in the 'Edit' menu or click on the corresponding tool.

A new virtual channel is created. This virtual channel's entry in the Module Tree appears under 'Without CAN-bus message'. If the virtual channel is to be transferred on the CAN-bus, it must be assigned to a message.

When a virtual channel is generated using the CANSAS operating software, it initially has default settings. There are different dialogs providing the ability to make settings for the virtual channel which are appropriate to your requirements. To do this, select the virtual channel's entry in the Module Tree. Clicking on one of the filecard tabs makes the desired dialog appear in the foreground.

General notes

This filecard contains the controls for the most basic parameters of a virtual channel. These are its name, comments, and Y-unit. The virtual channel's sampling rate is additionally displayed since it can differ from that of its parameter channels owing to the possibilities for data compression.



***Name*:** A designation unique within the CANSAS-module system, used to differentiate among the channels. Characters permitted in the name include the alphabet, numerals, "_" and "~", though the first character

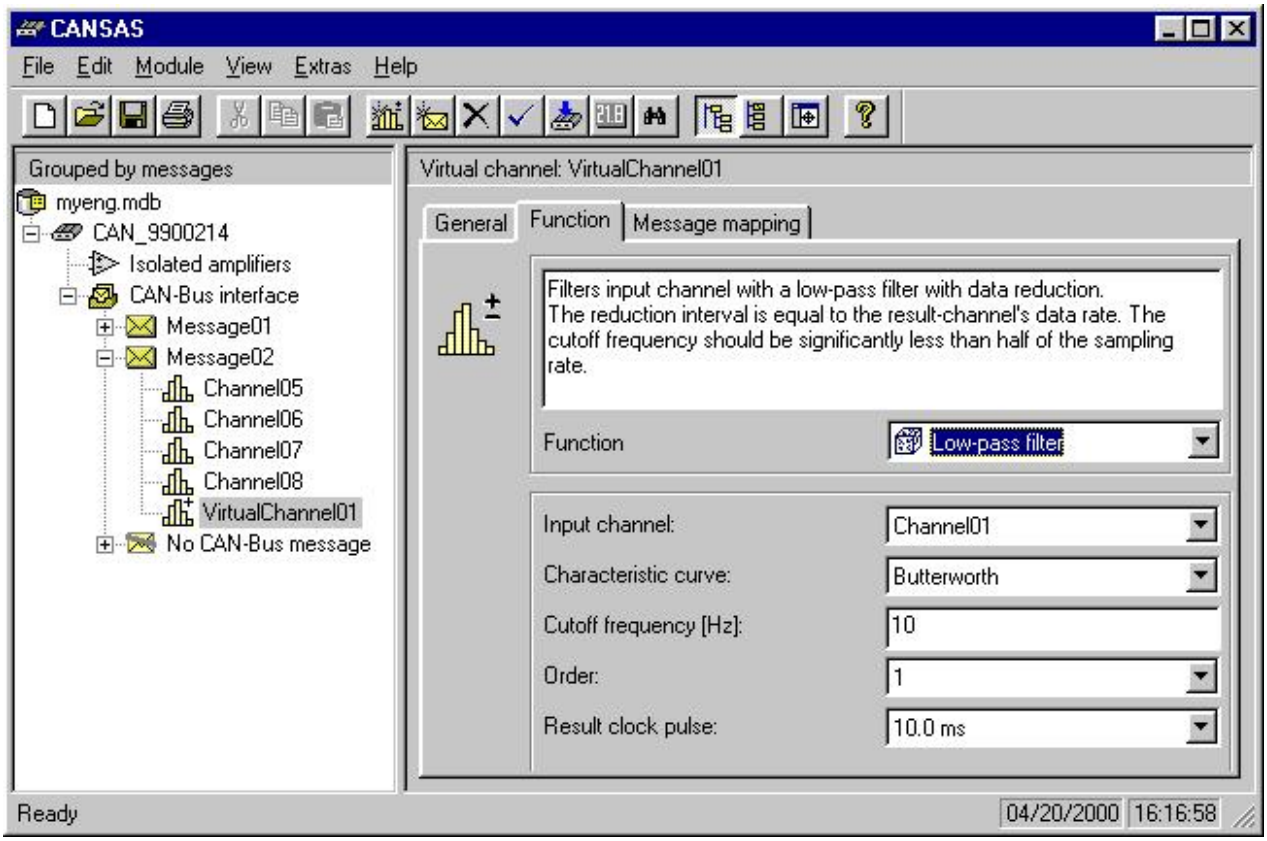
may not be a numeral. The name may take a maximum of 255 characters. The default name of a new virtual channels is "VirtualChannel_i", _i being the number of already present virtual channels + 1.

***Comment*:** A text accompanying the virtual channel. The text could be a detailed explanation of the virtual channel's name, or any other notes on the channel. It may take a maximum of 255 characters.

Unit: A drop-down list box offers a selection of units. An arbitrary text having up to 45 characters can also be specified.

Sampling interval: Indicates the virtual channel's sampling time which is derived from the parameter channels chosen and from the data compression specified.

Function: Specifies how the virtual channel is computed. This is done by selecting a calculational function and parameterizing it. The parameterizing process involves the Parameterize-dialog of the Formula Assistant, as in FAMOS or Online-FAMOS (imcDevices).



***Function*:** A selection of functions, arranged in groups (see the overview of functions 124 further down), is offered in a pop-down list box. Online help pertaining to the selected function is displayed.

Function parameters: The boxes below the function selection box are for setting the parameters. A description of the various functions' parameters can be found in the 'Function Reference'.

The functions generally take one or two channels as their parameters. The channels can be physical or already present virtual channels. If two channels are a function's parameters, they must share the same sampling rate.

If the functions can take numerical values as parameters for comparisons or other logical operations together with parameter channels, the values must be specified in the channel's physical units. It is then necessary to take the scaling (factor and offset) of the numerical value's parameter channel into account.

Message Mapping: See the information on input channel Properties 54 dialogs in Chapter Operation 99.

4.3 Data formats

The CANSAS-module supports the following data formats:

Data format	Size	Definition	Numerical range
Digital data format	1 bit	binary numbers	1 (TRUE) or 0 (FALSE)
Integer data format	2 byte	signed integers	-32767 ... +32767 or 8001h ... 7FFFh
Unsigned integer data format	2 byte	unsigned integers	0 ... +65535 or 0h ... FFFFh
Long data format	4 byte	signed integers	-2147483647 ... +2147483647 or 80000001h 7FFFFFFFh
Real data format	4 byte	Real numbers	-1,0E28 ... +1,0E28

Channels with Digital data format return only the values 1 (TRUE) or 0 (FALSE). The scaling offset and factor are 1,0 and 0,0, respectively.

Channels with Integer data format return integers as complements on two in the range from 8001h (corresponding to -32767) to 7FFFh (corresponding to 32767). The numerical range is symmetrical. The value 8000h (corresponding to -32768) isn't used. Each channel has its own scaling factor and offset. The integer values are multiplied with the factor and the offset is added to the product. This transformation yields real numbers in the desired numerical range.

Channels with Unsigned integer data format return integers in the range from 0h (corresponding to 0) to FFFFh (corresponding to 65535). Each channel has its own scaling factor and offset. The integer values are multiplied with the factor and the offset is added to the product. This transformation yields real numbers in the desired numerical range.

Channels with Long data format return integers in the range from 80000001h (corresponding to 2147483647) to 7FFFFFFFh (corresponding to 2147483647). Each channel has its own scaling factor and offset. This numerical format is only used by the incremental encoder module (totalizing events).

Channels with Real data format return real numbers in the range from -1,0E28 to 1,0E28. The numerical values have already been corrected with the scaling factor and offset. To transform a channel in Integer format to Real data format, the function "ToFloat" is available (see also "Conversion To Float 134" in the function reference). The Float-format as per IEEE is used. The results of calculational functions can be transformed to real numbers and transmitted on the CAN-bus. However, channels in Real data format cannot be subjected to calculational operations. Channels in Digital or Integer format can be subjected to appropriate calculational operations.

4.4 Integer-arithmetic

The CANSAS-module uses an integer processor. Calculational functions therefore must manage with 16-bit Integer-arithmetic. Computations with real numbers on the Integer-processor are possible in principle, but require excessive time. The computational functions' algorithms therefore are always compromises of processor time and precision.

The CANSAS-module mainly works with integers. The numerical range extends from -32767 to +32767 in whole numbers. Though scaling factor and offset can produce large real numbers, internally this small value range is all that is available for computations. This means that any real number range can be simulated, but that not every number within such a range can be expressed. There are always only 65535 different result values possible. Due to the number range's symmetry around the value 0 the number -32768 is not used.

For instance, with a factor of 1,0 and an offset of 0,0, the numerical range is -32767,0 ... +32767,0. A 13 as an integer stands for all value between 12,5 and 13,5. If the factor and offset are 100,0 and 0,0, 13 stands for all values from 1250 to 1350.

The results of computations can therefore in principle deviate from the technically correct value by 1 LSB. And some particular functions, such as inverse value, can deliver results which deviate from the expected results by several LSB's.

This difficulty is especially evident when multiplying two Integer-values: The result channel can also only be expressed as the Integer-values -32767 to +32767, just as the two channels which were multiplied. For instance, the product of 2^{15} and 2^{15} is 2^{30}. The value 2^{30} is reduced to 16 bits, so the lowest 16 bits are simply dropped. Taken together with technicalities of the value range scaling, cases can thus arise when 1 * 1 returns 0. But multiplication can be employed sensibly, as illustrated by the following example: Power = current * voltage. For measurement ranges of 0 .. 4 A for the current and 0 .. 5 V for the voltage, the result value range is 0 .. 20 W. The value range 0 .. 20 W can indeed be expressed sensibly with 16 bits.

4.5 Constraints

Virtual channels which aren't used are automatically omitted from calculations. Virtual channels which are results of certain functions having the reduction factor 1 (i.e., the input channel's sampling rate is the same as the result's) are automatically treated as an allocation (e.g. Maximum, Minimum, Average).

Certain functions automatically carry out re-scaling, which is necessary whenever differently scaled channels are jointly subjected to computational operations (Addition, Subtraction, etc.) or to cancel out an offset (e.g. for SQRT or high-pass filters). The ***re-scaling*** changes the factor and the offset. The factor and offset are indicated on the virtual channel's Message Mapping Properties dialog. Re-scaling and its effects on the factor and offset are not discussed in the function descriptions.

The re-scaling does, however, produce a loss of precision which must be taken into consideration. If two input channels with substantially differing scaling are combined in an operation, the discrepancy can become large indeed.

There are limits on the ***processing power***. In particular, CANSAS modules supporting high sampling rates (e.g. 10 kHz sampling rate for the digital data acquisition module DI16) will tend to exhaust the available processing resources when performing complex data processing at the highest possible sampling rate. However, by using data reduction (resampling and thus reduction of the data rate), even processing which is very taxing for such modules (for instance, filtering) can be carried out at a slower sampling rate. By contrast, CANSAS modules supporting only relatively slow sampling rates (for instance, the differential amplifier module C12 with a 500 Hz sampling rate) can indeed perform 4^{th} order high-pass filtering on all input channels at the top sampling rate.

The ***number of virtual channels*** available is limited to a total of 100. The available channels depend on the module, because a certain number of virtual channels are already used internally. For example to calculate the temperature of a thermocouple, the cold junction compensation has to be calculated. Therefore an internal channel has to be used, which is not visible to the user.

If one module has both messages configured with slow data rates and with high rates, it may occur that the rapid messages are delayed in being transmitted. This happens whenever several messages having a slow rate are transmitted in rapid succession, which of course takes up much time. This time amount can also be (significantly) greater than the fastest data rate. The corresponding messages can contain virtual or physical channels. The problem usually arises whenever very many channels or low Baud rates are set. One possible remedy might be a higher Baud rate.

4.6 LEDs

The CANSAS-module is equipped with one or more LED depending on the module. It is located to the right above the external power supply jack. It can shine red or green, or their combination yellow.

The manufactory default codes are described in chapter "Measurement technique" 188.

The LED can be under the user's control. The red and the green parts can each be set up just as virtual channels are. If both colors shine at once, it appears yellow. Making settings for the two color components can be accomplished using the CANSAS operating software via the Module Tree's entry "CAN-bus Interface" under "Without CAN-bus message". On the corresponding dialog pages, you can parameterize each of the color components in the same way as virtual channels.

An LED's control signal takes digital data format (1 (TRUE) corresponds to LED on and 0 (FALSE) to LED off). Any function whose result is in digital data format can be outputted by an LED. Here we will devote particular attention to the functions "Digital Constants" and "LED-Flash":

The function "Digital Constants" lets you generate digital functions. The constant's value is to be specified as either 0 (FALSE) or 1 (TRUE). When the constant is set to 1 (TRUE), the selected color component of the LED shines, otherwise is doesn't.

The "LED-Flash"-function makes the LED blink. For this purpose, the user must specify a pulse interval and how many pulses the LED is to shine and how many pulses it is to stay off. If "Flash" is set in the input box "Condition", the LED flashes the set color at the set pulse rate (see also "LED-Flash 140" in the Functions Reference).

To conserve computational capacity, functions with compressed input data are calculated with a time lag (see below under Sampling Rates 123). At pulse rates of 100 ms and higher, this phenomenon can be observed directly in yellow flashes (the red and green components flash on and off at an offset). Therefore it is recommended not to specify yellow flashes at higher rates than 50 ms.

The bridge amplifier module's two additional LEDs are also yellow. The red and green color components of these LEDs, however, are not separately programmable. Using the special bridge amplifier function "Output status on LED", info on the bridge amplifier's status can be output to these LEDs (see also "Output status on LED 147" in the function reference).

The LED card for these modules is status-oriented, i.e. there are no longer 1 or 2 LEDs, but only one (or more) module states. For each of the states listed, it is possible to set the LED and the flashing pattern by which it is indicated. For the description of the blinking code see µ-CANSAS and µ-CANSAS-HUB4 190.

4.7 Special module-specific characteristics

4.7.1 Acquisition modules

Depending on the module type, acquisition modules process either analog or digital input data. The isolation and bridge amplifier modules, for example, take analog input data, and the digital acquisition module DI16 takes digital data. The CANSAS module then sends the incoming data to the CAN-bus, either directly or after prior processing. Such prior processing is accomplished with the help of virtual channels; for instance, such a channel can contain the results of low-pass filtering applied to physical input data. After data processing, only the results are then transmitted by CAN-bus.

The raw data always consist of the physical or digital input signals, which can then be subjected to any desired processing. All channels assigned to a message are then transmitted by CAN-bus.

In order for data to be ready for transmission via CAN-bus, the bits or bytes to be transmitted must be assigned to specific channels. To do this, use the Drag & Drop technique to position the Module Tree entries of channels in messages. Virtual channels as well as physical inputs can be positioned in the messages. In the message mapping dialog, a message's bit and Byte assignments, the number and order of bits, the numerical format of the channel data being transmitted and the scaling factor and offset are all indicated.

4.7.1.1 ISO8, C8, INC4 and C12

Isolation module ISO8, Differential Amplifier modules C8 and C12 and Incremental encoder module INC4

Up to 12 physical inputs are available depending on module type.

Sample application: A low-pass filter is to be applied to a physical input channel's signal and the results are to be transmitted by CAN-bus. To do this, a virtual channel must be created and positioned in a CAN-message (via Drag & Drop). In the settings dialog for this virtual channel, a low-pass filter function can be selected and its parameters set.

4.7.1.2 BRIDGE2

Bridge amplifier module BRIDGE2

2 physical inputs are available. Like all CANSAS modules, this module has a programmable red/green LED. Unlike the other modules, it additionally has two more yellow LEDs which can be used, by means of a special function, to indicate status information. If the status information is only intended for transmission on the CAN-bus, the two yellow LEDs can be used for other output purposes.

The user of a bridge amplifier module needs to know certain information: are Channels 1 and 2 balanced or not? Or are the balancing values which are stored in the modules the ones for Channels 1 and 2? Is a balancing or shunt calibration currently being performed? The user has access to all this information. Such info can either be transmitted by CAN-bus in a status word in a message, and then evaluated at another location, or the information is indicated visibly by the additional yellow LEDs using the special function "Output status on LED". In order to be able to express many different states using just one LED, there are a number of different flashing patterns (LED on, LED off, LED blinks slow, normal, or fast, long flash on and short blink off or vice-versa). The various blinking patterns can be assigned to different states as desired. Module status can be indicated either for each of the two channels separately or for both together. It is recommended to use one yellow LED for the status info of Channel 1 and the other LED for Channel 2's info. The function "Output status on LED" can only be applied to the two extra yellow LEDs. See below in the functions' reference for a description of this function.

By default, the bridge amplifier module is not yet balanced when it is started. If balancing values are already stored, they are applied. It is generally recommended to have balancing performed unless the stored balancing values are to be used for a specific application. Balancing can be triggered either via the CAN-bus by pressing the module button. In order to be able to recognize the module's balance status, the use of the function "Output status to LED" is recommended. By this means, the module's status can be recognized by the pattern of LED flashing (for instance: LED off: no balancing values present; LED flashes slowly: stored balancing values applied; LED on: balancing performed successfully; LED flashing quickly: balancing currently being performed...).

The additional functions "Output status word", "Switch status", "Output status on LED" and "Short circuit status" are available to the bridge amplifier module. See below in the functions' reference for descriptions of these functions.

For a sample application, refer to the section on the isolated amplifier module.

4.7.1.3 P8

Pressure module P8

The pressure module has 8 physical channels.

The additional functions "Barometer" and "Status word" are available to this module under the function group heading "Pressure". See below in the functions' reference for descriptions of these functions.

For sample applications, refer to the material on the isolated amplifier module.

4.7.1.4 UNI8

Universal amplifier module UNI8

The universal amplifier module has 8 physical channels. Along with the red-green LED, it has 2 additional yellow LEDs, like the bridge amplifier does. These LEDs can be used for displaying module status information. For details, refer to the material on the bridge amplifier module.

The additional functions "Channel-status word", "Module-status word", "button status", "Status auf LED" and "short circuit status" are available to this module under the function group heading "Universal amplifier". See below in the functions' reference for descriptions of these functions.

For sample applications, refer to the material on the isolated amplifier module.

4.7.1.5 DI16

Digital acquisition module DI16

This module has 16 digital inputs.

The additional functions "Event counting", "Frequency determination", and "Time determination" are available to this module under the group heading "Pulse signals". See below in the functions' reference for descriptions of these functions.

Sample application: A digital input bit is to be inverted and the results are to be transmitted by CAN-bus. To do this, a virtual channel must be created and positioned in a CAN-message (using Drag & Drop). In the settings dialog for this virtual channel, the function "Logical NOT" can be selected and its parameters set.

4.7.2 Output modules

The output modules are DAC8, PWM8, DO16R and DO8R. These modules receive their data in messages via the CAN-bus. The CAN-messages can contain either analog or digital data. The channel data are extracted from the CAN-messages and then output on the process side either directly or after prior processing. Such prior processing is accomplished with the help of virtual channels; for instance, such a channel can contain the results of low-pass filtering applied to channel data received via CAN-bus. Depending on the module type, either analog data (in the case of the analog output module) or digital data (in the case of the digital output module) can be outputted.

If data are to be read in to the output module, the bits and Bytes to be read in must be assigned to channels. To do this, use the Drag & Drop technique to position the Module Tree entries of channels in messages. Virtual channels as well as physical outputs can be positioned in the messages. The channels assigned to a message are automatically set on the function "Read-in CAN channel". In the message mapping dialog, a message's bit and Byte assignments, the number and order of bits, and the numerical format of the channel data to be extracted can be set. For analog data, the minimum and maximum values can additionally be set. Virtual channels can be processed in any way desired and then outputted.

4.7.2.1 DAC8

Analog output module DAC8

At the 8 analog outputs, voltages in the range from -10 V to +10 V can be outputted. Channels read in from the CAN-bus and having this scaling, or virtual channels created with this scaling can be outputted directly. Otherwise the channels are automatically re-scaled, which results in a loss of precision. If for instance a 16-bit channel with an input range of -1 V ... +1 V is read in from the CAN-bus and is to be outputted, the values which are read in are automatically transformed into the value range -10 V ... +10 V. Of the values -32767 to +32767 on the CAN-bus, only the values -3276 to +3276 can be used for the D-A converter's output after scaling. This is because the range 1 V to +1 V is to be analog output. And if a channel with the input range 20 V..+20 V is transmitted by CAN-bus, the values outside of the range +10 V to -10 V are truncated.

For some special functions, the results are re-scaled because of the integer arithmetic. Thus, the addition of two channels scaled to ± 10 V results in a channel with an input range of ± 20 V. If this result is to be analog output, it is automatically re-scaled to ± 10 V.

The additional functions "Rectangle function", "Triangle", and "Sine" are available to this module under the group heading "Signal generator functions".

Sample application: A physical input channel is to be read in from the CAN-bus, subjected to low-pass filtering and outputted at the Analog Output 1. To do this, a virtual channel must first be created and positioned in a CAN-message using the Drag & Drop technique. In the message mapping dialog for this virtual channel, the position of the bits to be extracted in the message and the data type can be set. Then the low-pass filter function must be set in the function setting dialog for Analog Output 1, the virtual channel created must be set as the function's parameter channel and the other parameters must also be specified.

The module also can output currents in the range 0 mA to 20 mA. If the module is switched to current supply mode, its output is still scaled as -10 V...+10 V. All positive voltages from 0 V to +10 V are mapped to 0 mA..20 mA. No negative voltages can be mapped, since the current supply can only provide current in one direction.

4.7.2.2 PWM8

Pulse-width modulated output module PWM8

This module is quite similar to the DAC8-module. In contrast to the DAC8-module, its output values are not voltages in the range -10 V ... +10 V but rather results taking the form 0% … 100%.

The module doesn't come with any additional functions.

4.7.2.3 DO8R, DO16R

Digital output module DO16R, relay module DO8R

The digital output modules can only output digital signals. If an analog signal is read in from the CAN-bus, it must first be transformed to a digital signal, before it can become output. There are various functions for converting analog to digital data, such as the Schmitt-trigger function, the comparison functions or the function "Extract bit from word". Digital signals can be outputted either directly after being read in from the CAN-bus or after prior processing. For the processing of digital inputs, the bit-wise logical NOT function is available, for example.

Sample application: A digital input bit is to be read in from the CAN-bus, inverted and outputted at the Digital Output 1. To do this, a virtual channel must first be created and positioned in a CAN-message using the Drag & Drop technique. In the message mapping dialog for this virtual channel, the position of the bit to be extracted in the message and the data type (digital) can be set. Then the bit-wise logical NOT function must be set in the function setting dialog for Digital Output 1, the virtual channel created must be set as the function's parameter channel.

You can find further information about the modules, not concerning the Virtual Channels, in the chapter Properties of the Modules 215.

4.8 Sampling Rates

For the modules **ISO8** and **C12**, the allowed sampling intervals are 2 ms, 10 ms, 20 ms, 50 ms, ..., 1 min (other modules support faster sampling; for explanation purposes, a base rate of 2 ms is assumed). Virtual channels derived from functions without data compression have the same sampling rates as their parameter channels. If the function used to generate the virtual channel supports data compression, the resultant sampling rate can be smaller than that of the input channels (e.g. Maximum, Minimum, Average). The resultant sampling rate can never be greater than that of the input channels.

To conserve computational capacity, functions with compressed input data (e.g. sampling rate of 100 ms), are calculated with a time lag. The time lag has the effect that when data compression is present, more functions can be carried out simultaneously than if all the functions were applied at once to the same sample. This makes the processing of very involved configurations possible.

Take for instance 10 functions applied to data accumulating at a sampling rate of 10 ms. Instead of all the functions beginning to work immediately on the sample, one function's value is calculated at each ms after the sample arrives. This saves on computational exertion for the processor, but causes the results to be outputted with a time lag.

The larger a function's sampling rate is, the larger the time lag between its calculations can be. Interdependencies of parameters are, of course, unaffected. No data is lost, only the moment in which they are processed and in some cases when they are transmitted is delayed.

From a pulse rate of 100 ms onward, this phenomenon can be observed directly in the yellow flashing of the **LED**; the red and green components of the LED light flash with a mutual offset. Therefore, it's recommended to set a maximum sampling time of 50 ms for yellow LED flashing.

If one module has both messages configured with slow data rates and with high rates, it may occur that the rapid messages are delayed in being transmitted. This happens whenever several messages having a slow rate are transmitted in rapid succession, which of course takes up much time. This time amount can also be (significantly) greater than the fastest data rate. The corresponding messages can contain virtual or physical channels. The problem usually arises whenever very many channels or low Baud rates are set. One possible remedy might be a higher Baud rate.

4.9 Processing functions sorted by group

Arithmetic

- Addition
- Division
- Inverse
- Multiplication
- Negative sign
- Subtraction

Statistics

- Exponential RMS
- Maximum
- Minimum
- Mean value
- Resampling
- Root-mean-square (RMS)
- Standard deviation

Linear filters

- Band-pass-filter
- High-pass filter
- Low-pass filter
- Smoothing based on 2 values
- Smoothing based on 3 values

Non-linear filters

- Hysteresis filter
- Median filter
- Schmitt-Trigger
- Slope limiting

Basic math functions

- Absolute value
- Assignment
- Constant digital channel
- Constant channel
- Characteristic curve
- Fixed analog value
- SawTooth
- Square root

Comparison functions

- Comparison function
- Greater
- Upper value
- Lesser
- Lower value

Logic operations

- Logical exclusive OR
- Logical NOT
- Logical OR
- Logical AND
- Monoflop

LED-function

- LED-flash

Bitwise relationships

- Bit-wise NOT
- Bit-wise OR
- Bit-wise AND
- Extract bit from word
- Bitwise exclutesive OR

Conversion

- Conversion to Float numerical format (only inputmoduls)
- Fixed input range
- Fixed scaling

Signal generator (only at output modules)

- PulseSequenceEncoder
- Rectangle function (only DAC8)
- Sine (only DAC8)
- Triangle (only DAC8)

Pulse signals (only at DI16 module)

- Event counting
- Frequency determination
- Time determination

Bridge amplifier (only at BRIDGE2 module)

- Button status
- Output status on LED
- Short-circuit status
- Output status word

Universal amplifier (only at DCB8; UNI8 module)

- Button status
- Channel status word
- Module status word
- Output status on LED
- Short-circuit status

Pressure function (only at P8 module)

- Barometer
- Output status word

Differential amplifiers (only at C8 module)

- Output status word

Incremental encoder (only at INC4 module)

- Output status word

Scanner (only at SCxx module)

- Output status word

Isolated ampifier (only at CI8 module)

- Channal-status word
- Module-status word
- Output status on LED

4.10 Function Reference

4.10.1 + (Addition)

Parameter	Definition
1st parameter	Channel whose sample values are added to the 2nd parameter
2nd parameter	Channel whose sample values are added to the corresponding sample value from the 1st parameter, or numerical value added to each sample in the 1st parameter
Result channel	Channel containing the sum of the 1st and 2nd parameters

Description: The basic addition operation is carried out. The algorithm can be represented thus:

y [k] = u [k] + v [k] or y [k] = u [k] + c

where k is a serial index, c a constant numerical value, u and v are parameter channels and y the result channel.

Notes: If two channels are added, they must share the same sampling rate. If the 2nd parameteris a numerical value, it must have the same physical unit as the 1st parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameteris an input channel)	Integer
Integer or Digital	2nd parameteris a numerical value	Integer

4.10.2 - (Subtraction)

Parameter	Definition
1st parameter	Channel from whose sample values the values in the 2nd parameterare subtracted
2nd parameter	Channel whose sample values are subtracted from the corresponding sample value in the 1st parameter, or numerical value subtracted from each sample in the 1st parameter
Result channel	Channel containing the difference of the 1st and 2nd parameters

Description: The basic addition operation is carried out. The algorithm can be represented thus:

y [k] = u [k] - v [k] or y [k] = u [k] - c

where k is a serial index, c a constant numerical value, u and v are parameter channels and y the result channel.

Notes: If two channels are added, they must share the same sampling rate. If the 2nd parameteris a numerical value, it must have the same physical unit as the 1st parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameteris an input channel)	Integer
Integer or Digital	2nd parameteris a numerical value	Integer

4.10.3 - (Negative sign)

Parameter	Definition
Input channel	Channel whose values' signs are to be reversed.
Result channel	Input channel values with inverted sign.

Description: The signs of the input channel's samples are reversed. Positive numbers become negative and vice-versa; the absolute values remain unchanged.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.4 * (Multiplication)

Parameter	Definition
1st parameter	Channel whose sample values are multiplied with the 2nd parameter
2nd parameter	Channel whose sample values are multiplied with the corresponding sample value from the 1st parameter, or numerical value multiplied with each sample in the 1st parameter
Result channel	Channel containing the product of the 1st and 2nd parameters

Description: The basic multiplication operation is carried out. The algorithm can be represented thus:

$y[k] = u[k] * v[k]$ or $y[k] = u[k] * c$

where k is a serial index, c a constant numerical value, u and v are parameter channels and y the result channel.

Notes: If two channels are multiplied, they must share the same sampling rate.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameteris an input channel)	Integer
Integer or Digital	2nd parameteris a numerical value	Integer

4.10.5 / (Division)

Parameter	Definition
Input channel	Channel whose sample values are to be divided by a number
Value	Numerical value by which the sample values of the 1st parameter are to be divided
Result	Channel whose values are all divided by the number specified.

Description: The basic arithmetical operation Division is performed. The function follows the formula:

$y[k] = u[k] / c, \quad c \neq 0$

where k is the serial index, c a numerical constant, u is the input channel and y the result channel.

Notes: The numerical value must be specified in the physical units of the input channel. In physical units of the input channel, the value may not be 0.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.6 1/x (Inverse)

Parameter	Definition
Input channel	Channel whose sample values are to be inverted
Result channel	Inverse values of the input channel's sample values.

Description: The values from input channel are inverted. An input channel sample value of 0.0 is set as 0.0 in the result channel.

Notes: The results of the Inverse-function can be imprecise. It is therefore recommended to re-scale the input channel accordingly.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.7 Absolute value

Parameter	Definition
Input channel	The absolute values of this channel's samples are taken.
Result channel	Channel with the absolute values of the input channel's sample values.

Description: The absolute value of the input channel's sample values is determined. Positive values remain unaffected, negative values' signs are inverted. This function simulates an ideal rectifier.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

4.10.8 Assignment

Parameter	Definition
Input channel	Channel whose sample values are assigned to the result channel
Result channel	The input channel's sample values

Description: The input channel's values are directly assigned to the result channel; the result channel is a copy of the input channel.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

4.10.9 Band-pass filter

Parameter	Definition
Input channel	Channel to filter
Characteristic	Filter characteristic Butterworth Bessel Chebychev, ripple: 0.5 dB Chebychev, ripple: 1.0 dB Chebychev, ripple: 3.0 dB
Lower cut-off frequency	Lower cut-off frequency in Hz
Upper cut-off frequency [Hz]	Upper cut-off frequency in Hz
Result	Filtered input channel.

Description: Filtering of the input channel with a band-pass filter. A bilinear transformation is used to compute the filter coefficients from the other parameters. The filter applied is always a 4th order band-pass filter.

Notes: A condition for effective filtering is that the cut-off frequencies are significantly below half of the input channel's sampling rate. The closer the cut-off frequencies are to the input channel's sampling rate, the more imprecise the filter's amplitude response.

The cut-off frequency's input range depends on the input channel's sampling rate, the filter's order and on the filter characteristic.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.10 Barometer (only for P8 modules)

Parameter	Definition
Result clock pulse	Pulse rate of the result channel
Result channel	Channel with current barometer values

Description: The result is the barometer's current measurement value. The barometer value is updated about once per second.

Notes: The barometer value is specified in bar.

Data types:

Input channel	Result channel
Integer	Integer

4.10.11 Bitwise AND

Parameter	Definition
1st parameter	Channel whose sample values are conjunctioned bit by bit with the respective value from the 2nd parameter.
2nd parameter	Channel whose sample values are conjunctioned bit by bit with the respective value from the 1st parameter, or numerical value which is conjunctioned with each value from the 1st parameter
Result	Channel containing the results of the bit-wise logical conjunctions

Description: Bit by bit conjunction operation performed on the two parameters. The sample values of the input channel are treated as whole 16-bit numbers. If both corresponding bits of the parameters' sample values are set, the corresponding bit of the result channel is set also, otherwise it is not.

Notes: If the function is carried out on two channels, they must share the same sampling rate. If the 2nd parameter is a numerical value, it must be specified in the same physical units as the 1st parameter's values.

Data types:

1st input channel	2nd parameter	Result channel
Integer	Integer (2nd parameter is an input channel)	Integer
Integer	Digital (2nd parameter is an input channel)	Integer
Digital	Integer (2nd parameter is an input channel)	Integer
Digital	Digital (2nd parameter is an input channel)	Digital
Integer or Digital	2nd parameter is a numerical value	Integer

4.10.12 Bitwise NOT

Parameter	Definition
Input channel	Channel whose sample values are negated bit by bit
Result channel	Channel containing the results of the bit-wise negation

Description: The sample values of Input channel are negated bit by bit. Integer values are treated as 16-bit numbers and each individual bit is negated, which means that if a bit has the value 0 (FALSE), it becomes 1 (TRUE) and vice-versa. For digital input channels, the single digital bit's value is switched to the other binary value.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

4.10.13 Bitwise OR

Parameter	Definition
1st parameter	Channel whose sample values are disjunctioned bit by bit with the respective value from the 2nd parameter
2nd parameter	Channel whose sample values are disjunctioned bit by bit with the respective value from the 1st parameter, or numerical value which is disjunctioned with each vale from the 1st parameter
Result	Channel containing the results of the bit-wise disjunction.

Description: A bit by bit OR-operation is performed on the two parameters. The sample values of the input channel are treated as whole 16-bit numbers. If a bit is set in either of the parameters' sample values, the corresponding bit of the result channel is set (=1), otherwise it is not.

Notes: If the function is carried out on two channels, they must share the same sampling rate. If the 2nd parameter is a numerical value, it must be specified in the same physical units as the 1st parameter's values.

Data types:

1st input channel	2nd parameter	Result channel
Integer	Integer (2nd parameter is an input channel)	Integer
Integer	Digital (2nd parameter is an input channel)	Integer
Digital	Integer (2nd parameter is an input channel)	Integer
Digital	Digital (2nd parameter is an input channel)	Digital
Integer or Digital	2nd parameter is a numerical value	Integer

4.10.14 Bitwise exclusive OR

Parameter	definition
1st parameter	Channel, whose sample values are each to be subjected bit-by-bit to the XOR logic operation together with the sample values of the 2nd parameter.
2nd parameter	Channel, whose sample values are each to be subjected bit-by-bit to the XOR logic operation together with the sample values of the 1st parameters, or numerical value which is to be subjected to the XOR logic operation together with each of the sample values of the 1st parameter
Result	Channel with the results of the bit-wise XOR operation.

Description: The values of both parameters are jointly subjected bit-by-bit to the XOR logic operation. The sample values of the input channels consist of whole 16-bit numbers. If the bit corresponding to the current sample value is set for just one of parameters, that bit is set in the result, otherwise not.

Remark: For 2 channels to be subjected jointly to the XOR operation, they must both have the same sampling rate.

If the 2nd parameter is a numerical value, it must be expressed as a hexadecimal number in the form: 0xiiii ($0 \leq i \leq F$). If, as an example, you want to subject the lowest 3 bits of the sample values to the XOR operation, then the number 0x0007 must be specified as the 2nd parameter. If the operation should be performed only on the lowest bit (LSB), the number 0x0001 should be specified as the 2nd parameter.

Data types:

1st Input channel	2nd Parameter	Result channel
Integer or Unsigned Integer	Integer or Unsigned Integer (2nd parameter is an input channel)	Integer or Unsigned Integer
Integer or Unsigned Integer	Digital (2nd parameter is an input channel)	Integer or Unsigned Integer
Digital	Integer or Unsigned Integer (2nd parameter is an input channel)	Integer or Unsigned Integer
Digital	Digital (2nd parameter is an input channel)	Digital
Integer or Unsigned Integer	2nd parameter is a numerical value	Integer or Unsigned Integer
Digital	2nd parameter is a numerical value	Integer

4.10.15 Button status (only for BRIGDE2 and UNI8 modules)

Parameter	Definition
Result clock pulse	Clock pulse of result channel
Result channel	Channel representing button status signal

Description: Outputs button status of BRIDGE2 or UNI8 module at specified sampling rate. If the button was pressed the returned result is 1 for the duration of one pulse, else 0. When the button is pressed only the signal edge is evaluated, i.e. it doesn't matter how long the button is held down. If the button function is set to "Activate balance" or "Activate shunt calibration", the button only takes effect if balancing (or shunt calibration) can be performed. During balancing or shunt calibration, the button status is ignored.
Since it is the signal edge which counts, only a single 1 appears between sequences of zeroes.

Data types:

Result channel
Digital

4.10.16 Channel-status word (only for UNI8 and CI8 modules)

Parameter	Definition
Result clock pulse	Pulse rate of result channel
Result channel	Current content of input channel's status word.

Description: A status word for channels of the universal amplifier module is outputted at the specified clock pulse. In the basic state the status word's value is 0. Therefore channels 1 ... 8 are not balanced.

Depending on the status, the following values are added:

+1	if stored adjustment values are used for Channel 1
+2	if Channel 1 was successfully adjusted/balanced
+4	if stored adjustment values are used for Channel 2
+8	if Channel 2 was successfully adjusted/balanced
+16	if stored adjustment values are used for Channel 3
+32	if Channel 3 was successfully adjusted/balanced
+64	if stored adjustment values are used for Channel 4
+128	if Channel 4 was successfully adjusted/balanced
+256	if stored adjustment values are used for Channel 5
+512	if Channel 5 was successfully adjusted/balanced
+1024	if stored adjustment values are used for Channel 6
+2048	if Channel 6 was successfully adjusted/balanced
+4096	if stored adjustment values are used for Channel 7
+8192	if Channel 7 was successfully adjusted/balanced
+16384	if stored adjustment values are used for Channel 8
+32768	if Channel 8 was successfully adjusted/balanced

The function is designed for displaying bridge channels, i.e. channels, which can be balanced to 0.

Data types:

Result channel
Unsigned Integer

4.10.17 Characteristic curve

Parameter	**Definition**
Input channel	Channel to be corrected according to a characteristic curve
X-values	Specified input channel values
Y-values	Result values assigned to the input channel values
Result channel	Input channel corrected by the characteristic curve

Description: The input channel is corrected according to a characteristic curve. The input channel values (X-values) and corresponding result values (Y-values) must be supplied. The result values for X-values lying between two adjacent input channel values are determined by linear interpolation of the corresponding Y-values. It is necessary for equal numbers of X- and Y-values to be supplied. A maximum of 60 each of X and Y-values is allowed. The X-values must be strictly monotonously growing.

The X- and Y-value data can, for example, be copied from the FAMOS Data Editor and inserted in the corresponding input boxes.

Remark: The X-values are expressed in the physical units of the input channel. The scaling of the result is automatically determined from the result values.

Data types:

Result channel
Integer

4.10.18 Comparison function

Parameter	Definition
Input channel	Channel whose sample values determine whether the samples from 'Output channel' or the specified 'Result value' are adopted as return values of the function.
Output channel	Channel whose sample values are the function's return values if the Input channel's corresponding value is TRUE (<> 0).
Result value	Number which is the function's return value whenever the Input channel's value is FALSE (= 0).
Result channel	Channel containing the results of the decision function.

Description: If the current value of the digital input channel does not equal zero, the result is the value of the output channel, otherwise it is the stated return value.

Notes: Input channel and Output channel must share the same sampling rate. Result value must be specified in the physical units of Output channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.19 Constant channel (only for acquisition modules)

Parameter	Definition
Input channel	Channel whose values are to be set to a constant value
Value	Specified numerical value
Result channel	Constant-value channel.

Description: Any given value from the input channel is replaced with the specified, constant value.

Notes: The constant value is specified in the physical units of the input channel. The input channel's scaling remains intact.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.20 Constant digital channel

Parameter	Definition
Clock pulse	Data rate of result channel
Digital value	Numerical return value, 1 (TRUE) or 0 (FALSE).
Result channel	Constant digital channel.

Description: Generates a constant digital channel with the specified pulse rate and binary value 1 (TRUE) or 0 (FALSE).

Data types:

Result channel
Digital

4.10.21 Conversion to Float numerical format (only for acquisition modules)

Parameter	Definition
Input channel	Channel whose values are to be expressed in Float numerical format
Result channel	Values from Input channel expressed in Float numerical format

Description: Conversion of an integer (2 Byte) to a real number (4Byte) giving regard to the scaling factor and offset. The real number is determined by the algorithm:

y [k] = Factor * u [k] + Offset

where k is a serial index and u an input channel in Integer data format (devoid of scaling, i.e. without scaling factor or offset) y is the result channel in Real data format. Factor is the input channel's scaling factor and Offset Input channel's offset.

Data types:

Input channel	Result channel
Integer or Digital	Real

4.10.22 Event counting (only for DI16 modules)

Parameter	Definition
Input channel	Digital input channel in whose signal events are to be counted
Result clock pulse	Clock pulse rate of results channel
Result channel	Channel containing number of events.

Description: Returns number of events occurring at the digital channel within one result clock pulse period. An event is a transition from 0 to 1 (or nonzero), i.e., a positive edge.

Notes: Only digital input channels are allowed. The input channel's sampling rate may only be 0.1 ms, 0.2 ms, 0.5 ms or 1 ms.

Data types:

Input channel	Result channel
Digital	Integer

4.10.23 Exp. root mean square (RMS)

Parameter	Definition
Input channel	Channel from whose sample values the moving RMS is to be calculated
Time constant	Time constant of the filter in s, Input range: 1.5 * Result pulse < Time constant ≤ 60000 * Result pulse
Result clock pulse	Sampling rate of the result channel
Result channel	Moving RMS of the input channel's sample values

Description: The moving RMS, with exponential weighting, of the input channel's sample values is calculated. If data reduction is specified, only every n-th result is written to the result channel. The reduction interval is the result channel's sampling rate (pulse). Each value returned is the respective RMS with exponential weighting of all input channel sample values accumulated at the moment. The algorithm for calculating the moving RMS is:

The input channel's sample values are first squared, then 1st order low-pass filtering (taking consideration of the time constant) is conducted and then the square root is taken. In a normal RMS calculation, all squared values are weighted equally when the mean is taken; in this case, a time-based weighting takes place.

Notes: Data reduction is recommended since the function smoothes the data. The reduction tends to reduce redundant data.

The pulse rate of the result channel may not be higher than that of the input channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.24 Extract bit from word

Parameter	Definition
Input channel	Channel from whose sample values a bit is to be extracted
Bit to be extracted	Bit 1 (LSB) .... Bit 16 (MSB)
Result channel	Channel containing extracted bit

Description: The specified bit is extracted from a number. The result is a bit, i.e. either 0 (FALSE) or 1 (TRUE). The 2nd parameter states the bit which is to be extracted: Bit 1 (LSB) .... Bit 16 (MSB).

Data types:

Input channel	Result channel
Integer	Digital
Unsigned Integer	Digital

4.10.25 Fixed analog value (only for DAC8 and PWM8 modules)

Parameter	Definition
Value	Fixed analog value, -10V ... +10V.
Result channel	Channel with constant (fixed) analog value

Description: Creates a channel with a fixed (constant) value. The value can be set to between -10V and +10V.

Data types:

Result channel
Integer

4.10.26 Fixed digital value (only for digital output modules)

Parameter	Definition
Digital value	Constant (fixed) digital value, either 0 (FALSE) or 1 (TRUE).
Result channel	Channel with constant (fixed) digital value

Description: Creates a channel with a fixed (constant) value. The value can be set to either 0 (FALSE) or to 1 (TRUE).

Data types:

Result channel
Digital

4.10.27 Fixed input range

Parameter	Definition
Input channel	Channel to be re-scaled
Minimum	New lower limit of the value range
Maximum	New upper limit of the value range
Result channel	Re-scaled input channel

Description: The value range of a channel is re-scaled according to the user's specifications. The new range is defined by a new lower range limit (minimum) and a new upper range limit (maximum). All the input channel's sample values are linearly transformed to the result channel's new value range.

Notes: The function can only be carried out if the degree of stretching or contraction of the value range derived from the minimum and maximum is not too large.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.28 Fixed scaling

Parameter	Definition
Input channel	Channel to be re-scaled
Factor	New scaling factor, which together with the new offset determines a new value range
Offset	New offset, which together with the new scaling factor determines a new value range
Result channel	Re-scaled Input channel

Description: The value range of a channel is re-scaled on the basis of the new scaling factor and offset supplied by the user. The new lower range limit L_L and the new upper range limit L_U are calculated by:

$L_L = -32767 * |Factor| + Offset$ and $L_U = +32767 * |Factor| + Offset$

All sample values of the input channel are linearly transformed to fit the new result channel value range.

Notes: The function can only be carried out if the degree of stretching or contraction of the value range derived from the specified scaling factor and offset is not too large.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.29 Frequency determination (only for DI16 modules)

Parameter	Definition
Input channel	Channel for which a frequency is to be determined
Input range	The following input ranges can be set: 30 Hz 60 Hz 125 Hz 250 Hz 400 Hz 800 Hz 2 kHz 4 kHz
Result clock pulse	Clock pulse rate of results channel
Result channel	Results of frequency determination

Description: Determines a signal frequency for the digital input signal. The function's action is a combination of event counting and time measuring. An event is a transition from 0 to 1 (nonzero), i.e., a positive edge. During a sampling interval the events occurring as well as the time between the first and last occurrence are measured. The frequency is computed as the number of events divided by the time between the first and last complete event within the interval. An event is completed when the positive edge is succeeded by a subsequent positive edge. In order for a frequency to be determined, then, at least two complete events must be located within the interval.

If the frequency determined exceeds the input range, the result value is set to the specified input range's endpoint.

If no frequency can be determined for a result clock pulse interval, the last frequency result is repeated. If multiple frequencies are determined during one result clock pulse interval, the most recent result is returned.

Notes: The input range and the module's sampling rate influence the precision of the frequency measurement. Only digital input channels are allowed.

The input channel's sampling rate may only be 0.1 ms, 0.2 ms, 0.5 ms or 1 ms. The higher the sampling rate is, the more exactly the frequency can be determined.

For the most precise frequency measurements, use the incremental encoder module INC4.

Data types:

Input channel	Result channel
Digital	Integer

4.10.30 Greater

Parameter	Definition
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Digital channel; result value is respectively TRUE (1), if 1st parameter value > 2nd parameter value FALSE (0), if 1st parameter value ≤ 2nd parameter value

Description: The function determines whether the 1st parameter value is larger than the 2nd parametervalue. If the 1st parameter is greater, then 1 is returned, otherwise 0 is returned.

Notes: If 2 channels are to be compared with each other, they must share the same sampling rate. If the 2nd parameteris a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st input channel	2nd parameter	Result channel
Integer or Digital	Integer or Digital (2nd parameters input channel)	Digital
Integer or Digital	2nd parameters number	Digital

4.10.31 Greater value

Parameter	Definition
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Channel containing the respective highest sample value of the two parameters

Description: The function determines which value from the two parameters is the highest.

Notes: If 2 channels are to be compared with each other, they must share the same sampling rate. If the 2nd parameter is a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st Input channel	2nd parameter	Result channel
Integer	Integer (2nd parameteris input channel)	Integer
Integer	Digital (2nd parameteris input channel)	Integer
Digital	Integer 2nd parameteris input channel)	Integer
Digital	Digital (2nd parameteris input channel)	Digital
Integer or Digital	2nd parameteris a number	Integer

4.10.32 High-pass filter

Parameter	Definition
Input channel	Channel to be filtered
Characteristic	Filter characteristic Butterworth Bessel Chebychev, ripple: 0.5 dB Chebychev, ripple: 1.0 dB Chebychev, ripple: 3.0 dB
Cut-off frequency	Specified in Hz
Order	Filter order 1 2 3 4
Result	Filtered input channel

Description: Filtering of the input channels with a high-pass filter. The filter coefficients are calculated from the parameters supplied by the user.

Notes: A condition for effective filtering is that the cut-off frequencies are significantly below half of the input channel's sampling rate. The closer the cut-off frequencies are to the input channel's sampling rate, the more imprecise the filter's amplitude response.

The cut-off frequency's input range depends on the input channel's sampling rate, the filter's order and on the filter characteristic.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.33 Hysteresis filter

Parameter	Definition
Input channel	Channel to be filtered
Hysteresis width	Hysteresis width, for suppressing minor fluctuations
Result channel	Filtered input channel

Description: The hysteresis filters minor oscillations up to the size of the hysteresis width out of the input channel. The algorithm is as follows:

The 1st result value is set as the 1st sample value from the input channel. The trend is set as an upward trend.

If the signal is currently in an upward trend, then one of the three procedures below is followed, depending upon the status of the current signal value in the input channel:

- If the current signal value from the input channel is greater than the last value in the result channel, the current value in the input channel is adopted as the current value of the result channel.
- If the current signal value from the input channel is less than or equal to the last value in the result channel, but not less than: the last result channel value minus the hysteresis width (i.e., the negative discrepancy to the last value is within a tolerance range stated as the hysteresis width), the last result channel value is retained as the current result channel value.

- If the current signal value from the input channel is less than the last result channel value minus the hysteresis width (i.e., the negative discrepancy to the last value is outside the tolerance range stated as the hysteresis width), the current signal value from the input channel becomes the current value of the result channel, and the prevalent signal trend is now downward.

If the signal is currently in a downward trend, then one of the three procedures below is followed, depending upon particulars of the current signal value in the input channel:

- If the current signal value from the input channel is less than the last value in the input channel, the current value in the input channel is adopted as the current value of the result channel.
- If the current signal value from the input channel is greater than or equal to the last value in the result channel, but not greater than: the last result channel value plus the hysteresis width (i.e., the positive discrepancy to the last value is within a tolerance range stated as the hysteresis width), the last result channel value is retained as the current result channel value.
- If the current signal value from the input channel is greater than the last result channel value plus the hysteresis width (i.e., the positive discrepancy to the last value is outside the tolerance range stated as the hysteresis width), the current signal value from the input channel becomes the current value of result channel, and the prevalent signal trend is now upward.

Notes: The hysteresis width is specified in the physical units of the input channel and must be ≥ 0. A hysteresis width of 0 returns the input channel as the result.

Data types:

Input channel	**Result channel**
Integer	Integer
Digital	Digital

4.10.34 LED-flash

Parameter	**Definition**
Result clock pulse	Result channel pulse rate
Clock pulse, LED on	Number of pulses during which the function returns 1 (TRUE) as the result, Value range: 0 ... 60000.
Clock pulse, LED off	Number of pulses during which the function returns 0 (FALSE) as the result, Value range: 0 ... 60000.
Condition	Flash Flash for overflow
Result channel	Channel containing results of the LED-flashing function.

Description: By assigning the function to an LED, the LED's flashing pattern can be set. At the pulse rate specified, the LED shines during the number of pulses specified for "LED on" and stays off during the number of pulses specified for "LED off", if the specified condition is met. Otherwise, the LED is off altogether.

If the condition 'Flash' is set, Parameters 2 and 3 are evaluated in the manner described; the channel data value is 1 (TRUE) during the pulses for which "LED on" is specified, and for the other pulses the return value is 0 (FALSE). If the function is applied to an LED, the LED will flash correspondingly.

If the condition 'Flash for Overflow' is set, Parameters 2 and 3 are evaluated in the manner described only if the CANSAS module FIFO's overflow (and thus the module is overloaded); in such a case, some data will not be processed or transferred via the CAN-bus. Otherwise, the function's return value is 0 (FALSE). If the function is applied to an LED, LED flashing indicates system overload.

Notes: The function can also be used to generate a rectangular signal. For this purpose, the LED-flash function must be assigned to a virtual channel. The result channel can be re-scaled if appropriate.

Data types:

Result channel
Digital

4.10.35 Less

Parameter	Definition
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Digital channel; result value is respectively TRUE (1), if 1st parameter value < 2nd parameter value FALSE (0), if 1st parameter value ≥ 2nd parameter value

Description: The function determines whether the 1st parameter value is less than the 2nd parameter value. If the 1st parameter is lesser, then 1 is returned, otherwise 0 is returned.

Notes: If 2 channels are to be compared with each other, they must share the same sampling rate.

If the 2nd parameter is a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st input channel	2nd parameter data type	Result channel
Integer or Digital	Integer or Digital (2nd parameter is an input channel)	Digital
Integer or Digital	2nd parameter is a number	Digital

4.10.36 Less value

Parameter	Definition
1st parameter	Channel whose sample values are to be compared with the appropriate value from the 2nd parameter
2nd parameter	Channel whose samples are to be compared with the corresponding values from the 1st parameter or numerical value with which the sample values of the 1st parameter are to be compared
Result channel	Channel containing the respective lowest sample value of the two parameters

Description: The function determines which value from the two parameters is the lowest.

Notes: If 2 channels are to be compared with each other, they must share the same sampling rate. If the 2nd parameter is a number, it must be specified in the same physical units as the 1st parameter.

Data types:

1st Input channel	2nd parameter data type	Result channel
Integer	Integer (2nd parameter is input channel)	Integer
Integer	Digital (2nd parameter is input channel)	Integer
Digital	Integer 2nd parameter is input channel)	Integer
Digital	Digital (2nd parameter is input channel)	Digital
Integer or Digital	2nd parameter is a number	Integer

4.10.37 Logical AND

Parameter	Definition
1st input channel	Channel whose sample values are conjunctioned with the respective value from the 2nd parameter.
2nd input channel	Channel whose sample values are conjunctioned with the respective value from the 1st parameter
Result channel	Digital channel containing the conjunction results.

Description: Logical conjunction of the two input channels. If the corresponding sample values from the two channels are both nonzero, the return value is 1; otherwise the return value is 0. Therefore, the following condition must be fulfilled so that the return value is 1:

$u[k] \neq 0$ and $v[k] \neq 0$

where k is a serial index, and v are the two input channels.

Notes: Both channels must share the same sampling rate.

Data types:

1st input channel	2nd input channel	Result channel
Integer or Digital	Integer or Digital	Digital

4.10.38 Logical NOT

Parameter	Definition
Input channel	The data to be negated
Result channel	Digital channel containing the results.

Description: The input channel is logically negated. The return value is 1 if the sample value is 0, otherwise the return value is 0.

Data types:

Input channel	Result channel
Integer or Digital	Digital

4.10.39 Logical OR

Parameter	Definition
1st input channel	Channel whose sample values are disjunctioned with the respective value from the 2nd parameter
2nd input channel	Channel whose sample values are disjunctioned with the respective value from the 1st parameter
Result channel	Digital channel with the disjunction results.

Description: Disjunction operation performed on two channels. The return value is 1 whenever one of the sample values from the two channels is nonzero. Otherwise, the return value is 0. Therefore, one of the following two conditions must be fulfilled so that the return value is 1:

$u[k] \neq 0$ or $v[k] \neq 0$

where k is a serial index, and v are the two input channels.

Note: Both channels must share the same sampling rate.

Data types:

1st Input channel	2nd Input channel	Result channel
Integer or Digital	Integer or Digital	Digital

4.10.40 Logical exclusive OR

Parameter	Definition
1st input channel	Channel whose sample values are disjunctioned with the respective value from the 2nd parameter
2nd input channel	Channel whose sample values are disjunctioned with the respective value from the 1st parameter
Result channel	Digital channel containing the disjunction results.

Description: Exclusive disjunction operation performed on two channels. The return value is 1 whenever the corresponding sample values from each of the two channels are logically opposites. Otherwise, the return value is 0. Therefore, one of the following two conditions must be fulfilled so that the return value is 1:

$(u[k] = 0$ and $v[k] \neq 0)$ or $(u[k] \neq 0$ and $v[k] = 0)$

where k is a serial index, and v are the two input channels.

Notes: Both channels must share the same sampling rate.

Data types:

1st Input channel	2nd Input channel	Result channel
Integer or Digital	Integer or Digital	Digital

4.10.41 Low-pass filter

Parameter	Definition
Input channel	Channel to filter
Characteristic curve	Filter characteristic Butterworth Bessel Chebychev, ripple: 0.5 dB Chebychev, ripple: 1.0 dB Chebychev, ripple: 3.0 dB
Cut-off frequency	Specified in Hz
Order	Filter order 1 2 3 4
Result clock pulse	Result channel data rate
Result	Filtered input channel.

Description: Filtering of the input channels with a low-pass filter. The filter coefficients are calculated from the parameters supplied by the user.

Notes: A condition for effective filtering is that the cut-off frequencies are significantly below half of the input channel's sampling rate. The closer the cut-off frequencies are to the input channel's sampling rate, the more imprecise the filter's amplitude response.

The cut-off frequency's input range depends on the input channel's sampling rate, the filter's order and on the filter characteristic.

The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.42 Maximum

Parameter	Definition
Input channel	Channel whose maxima within each reduction interval are to be determined
Result clock pulse	Data rate of result channel
Result channel	Channel with the maxima of the input channel within the data reduction interval.

Description: The maximum values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the maxima found.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

4.10.43 Mean value

Parameter	Definition
Input channel	Channel whose mean values within each reduction interval are to be determined
Result clock pulse	Data rate of result channel
Result channel	Smoothed input channel

Description: The mean values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the mean values found.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.44 Median filter

Parameter	Definition
Input channel	Channel to filter
Result channel	Filtered input channel.

Description: Performs median filtering on the last 3 sample values. The 3 sample values are ordered by their amplitude. The return value is the middle value in the ordered set. The result channel's first two values are the same as those of the input channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.45 Minimum

Parameter	Definition
Input channel	Channel whose minima within each reduction interval are to be determined
Result clock pulse	Data rate of result channel
Result channel	Channel containing the minima of the input channel within the data reduction interval.

Description: The minimum values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the minima found.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

4.10.46 Module-status word (only for UNI8 and CI8 modules)

Parameter	Definition
Result clock pulse	Sampling rate of result channel
Result channel	Current content of result channel's status word

Description: Status word for universal amplifier module is outputted at the specified clock rate. In the basic state, the status word takes the value 0.

Depending on the status, the following values are added:

+1, if system is in the process of adjusting/balancing
+2, if system is in the process of performing shunt calibration
+4, if the module button is pressed (edge detection)
+8, if short circuit
+16, if the module is running in synchronized mode

Remark: If the function of the module button is set to "Activate balance " or "Shunt calibration", the system only takes not of the button if it is possible to perform calibration or adjustment/balancing. During balancing or shunt calibration, the button status is not regarded.

It is possible to run multiple CANSAS-modules in synchronicity to each other, to the DCF-signal or to μ MUSYCS. For synchronized operation, the corresponding status value is added.

Data types:

Result channel
Unsigned Integer

4.10.47 Monoflop

Parameter	Definition
Input channel	Channel on which to perform the function.
Duration	Duration of the output pulse as a multiple of samples; range: 1 ... 65535
Re-triggerable?	Optionally yes or no
Result channel	Digital channel containing the evaluated pulses

Description: The monoflop outputs an impulse in response to signal value transitions from zero to nonzero. The return value is 1 during the impulse duration, otherwise 0. If the monoflop is not re-triggerable, the zero-to-nonzero transition is only detected after an existing impulse is completed. If it is retriggerable, the transition detection is always active and the response to a new transition to nonzero is a new impulse which accordingly prolongs the existing impulse.

Data types:

Input channel	Result channel
Integer or Digital	Digital

4.10.48 Output status on LED (only for BRIDGE2, UNI8 and CI8 modules)

Parameter	Definition
BRIDGE2: Output status for	The channel whose status is to be represented by the LED. Channel 1, Channel 2 or both
UNI8: Other or no sensors	The flashing pattern for the case that other or no sensors are connected to the module. See below for selection.
For "Not balanced"	What flashing pattern indicates that the channel has not been balanced? LED on LED off LED quick flashes LED normal flashes LED slow flashes LED long flash on, short blink off LED short blink on, long flash off
For "Stored balance values"	Sets flashing pattern for indicating that stored balance values used for channel. Selections see above.
For "Successfully balanced"	Sets flashing pattern for indicating that balance values used for channel. Selections see above.
For "Balance in progress…"	Sets flashing pattern for indicating that balance is in progress. Selections see above.
For "Shunt calibration in progress"	Sets flashing pattern for indicating that shunt calibration in progress. Selections see above. Additional selection: "No LED-display"
Result	LED-display

Description:

BRIDGE2: Status information on the bridge amplifier module is outputted on the LED. The information can reflect the status of either Channel 1, Channel 2, or both. If both channels are affected at once, the status must be the same in both for the corresponding LED-display to be output. See the table below for a list of the different states which can be represented:

For determining the status of both channels at once, the following must be noted: All status values except "Successfully balanced" and "Not balanced" can only apply to both channels at once, anyway, so they are the same for both channels. And if the channels have different status in terms of "balanced" or "Not balanced", then "Not balanced" takes precedence.

Universal amplifier module:

The status of the universal amplifier module's bridge channels is indicated by an LED. The function is designed for displaying bridge channels, i.e. channels which can be balanced to 0. As a rule, the status for all of the module's bridge channels is indicated. All status values except "Successfully balanced" and "Not balanced" can only apply to both channels at once, anyway, so they are the same for both channels. And if the channels have different status in terms of "balanced" or "Not balanced", then "Not balanced" takes precedence. If no bridge channel is configured, the flashing pattern will indicate "Successfully balanced".

If at least one sensor connected to the module was changed, the flashing pattern for "Other or no sensors" is displayed. This can mean that a connected sensor was disconnected, that a sensor was exchanged for another one or that a sensor was connected at a previously free terminal. The module only recognizes the change once it has been re-booted, e.g., briefly disconnected from the power supply.

Status	Definition
"not balanced"	The Flash doesn't contain stored balancing values, and balancing has not been performed since the module was activated.
"Stored balance values"	The balance values stored in the Flash are used, and balancing has not been performed since the module was activated.
"Successfully balanced"	Balancing has been performed since the module was activated.
"Balance in progress"	Balancing currently being performed.
"Shunt calibration in progress"	Shunt calibration currently being performed.

Data types:

Result channel
LED display

4.10.49 Output status word (only for BRIDGE2, C8, P8, INC4 and SC modules)

Parameter	Definition
Result clock pulse	Data rate of result channel
Result channel	Channel containing status word

Description: The status word is outputted at the specified clock rate. In the basic state, the status word is 0. Depending on the status and module, the following values are added to the status word:

Bridge amplifier module:

In the basic state (status word = 0), the bridge amplifier channels 1 and 2 are not balanced. Depending on the status, the following values are added:

+1 if stored balance values used for Channel 1
+2 if Channel 1 successfully balanced
+4 if stored balance values used for Channel 2
+8 if Channel 2 successfully balanced
+16 if balance currently being performed
+32 if shunt calibration currently being performed
+64 if button pushed (edge evaluation)
+128 if short circuit

Notes: If the button function is set to "Activate balance" or "Activate shunt calibration ", the button only takes effect if balancing (or shunt calibration) can be performed. During balancing or shunt calibration the button status is ignored.

Differential amplifier-, pressure- and incremental encoder modules:

Depending on the status, the following values are added:

+1, if the module is running in synchronized mode

Remark: It is possible to run multiple CANSAS-modules in synchronicity to each other, to the DCF-signal or to μMUSYCS. For synchronized operation, the corresponding status value is added. In synchronized operation, 1 is added to the status value.

Data types:

Result channel
Unsigned Integer

4.10.50 PulseSequenceEncoder (only for output modules)

Parameter	Definition
Frequency curve [Hz]	Frequency curve read out from CAN-bus, from which a sequence of pulses is to be generated.
Result channel	Sequence of pulses

Description: This function generates a sequence of pulses like those typical of incremental encoders. The pulse rate is determined by the sampling rate of the function's parameter channel. If the function is applied to a channel sampled at 10 kHz, for instance, then a measured frequency on that channel of 2.5 kHz results in the series 001100110011... If the frequency changes to 1.25kHz, the pulse sequence becomes 0000111100001111....

Notes: The parameter channel's signal must have only positive values. In spite of this, a signed quantity can serve as the parameter. For example, if a signal's range is given as -100Hz to +100Hz, only values > 0 will actually appear. Since the module works internally with signed quantities, a symmetric input range is actually even advantageous for the sake of the processing speed.

Note also that due to the discrete output rate, the output pulse signal is less precise the higher the measured frequency is.

Data types:

Input channel	Result channel
Integer	Digital

4.10.51 Rectangle (only for DAC8 modules)

Parameter	Definition
Result clock pulse	Data rate of result channel.
Cycles with "high" pulse	Number of sample intervals with "high" pulse as output
Cycles with "low" pulse	Number of sample intervals with "low" pulse as output
Amplitude with "high" pulse	Amplitude of "high" pulse in V?
Amplitude with "low" pulse	Amplitude of "low" pulse in V?
Results channel	Rectangular signal

Description: Output of a rectangular signal at the voltage output. The parameters to be set are the clock cycle for the function, the duration of the "high" pulse, and the amplitude in V. The number of cycles with a pulse multiplied by the specific clock cycle equals the duration of the "high" pulse. The number of cycles without a pulse multiplied by the clock cycle equals the duration of the "low" pulse. The amplitude of the "high" and "low" can be freely specified in the range from -10 V to +10 V.

Resulting frequency = 1 / ((No. of cycles with pulse + no. of cycles without pulse) * result clock rate).

Data types:

Result channel
Integer

4.10.52 Resampling

Parameter	Definition
Input channel	Channel to be re-sampled
Result clock pulse	Data rate of result channel
Result channel	Re-sampled input channel

Description: The mean values within each reduction interval in the channel are determined. The reduction interval is the clock pulse of the result channel. The values returned are a sequence of the respective last values within the reduction interval.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer	Integer
Digital	Digital

4.10.53 Root-mean-square

Parameter	Definition
Input channel	Channel from whose sample values the moving RMS is to be calculated
Result clock pulse	Sampling rate of the result channel
Result channel	Channel containing the moving RMS of the input channel's sample values

Description: The moving RMS (root-mean-square) value, with equal weighting of the values, is taken for each set of the input channel's sample values within the specified reduction interval. The reduction interval is given by the result channel's sampling rate (pulse).

The algorithm for calculating the moving RMS is:

The input channel's sample values within the reduction interval are squared and the squares are summed. The respective result is divided by the amount of samples in the reduction interval and of this the square root is taken.

Note: The pulse rate of the result channel may not be higher than that of the input channel.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.54 SawTooth

Parameter	Definition
Clock pulse	Data rate of result channel
Number of points	Number of points making up a single period; value range: 1 ... 32768.
Start	Starting value, offset of the sawtooth signal
Increment	Increment, slope of the offset signal.
Result channel	Sawtooth-signal

Description: Generates a sawtooth signal. The data rate of the return values is given by the clock pulse specified. The signal's values are arranged in groups of consecutive values; each group's amount of values is given by 'Number of points', and each group's first value is the value given for 'Start'. The subsequent values in each group are the sum of the respective last return value and the 'Increment'-value specified.

Notes: Start-value and Increment must be specified in terms of the input channel's physical units.

Data types:

Result channel
Integer

4.10.55 Schmitt-Trigger

Parameter	Definition
Input channel	Channel to be filtered
Upper limit	Upper signal value which releases trigger
Lower limit	Lower signal value which releases trigger
Result channel	Filtered input channel

Description: A Schmitt-trigger with an upper and a lower threshold. The function generates ideal, square pulses. The only two possible return values are 0 and 1. The function can be used to reconstruct noisy signals for the purpose of subsequent processing, eliminating the noise. However, the shape of the original signal is also lost. The greater the distance between the two threshold values, the less susceptible the Schmitt-trigger is to noise.

The function uses the following algorithm:

For a non-negative scaling factor, the first return value is 1, otherwise 0.

If the last return value was 0, the new return value is 1 if the signal's sample value exceeds the upper threshold; otherwise, it is 0.

If the last return value was 1, the new return value is 0 if the signal's sample value drops below the lower threshold; otherwise, it is 1.

Both of these steps are performed on each sample value in the input channel.

Notes: The upper and lower limit must both be specified in terms of the input signal's physical units.

The upper limit's value must be greater than that of the lower limit.

A Schmitt-trigger is useful in cases where the important aspects of a sequence of pulses are the amount of pulses and their relative positions, but not their exact shape.

Data types:

Input channel	Result channel
Integer or Digital	Digital

4.10.56 Short circuit status (only for BRIDGE2 and UNI8 modules)

Parameter	Definition
Result clock pulse	Data rate of result channel
Result channel	Channel containing short-circuit status

Description: Outputs short-circuit status of module at specified sampling rate. Result is 1 in case of short circuit, else 0.

Data types:

Result channel
Digital

4.10.57 Sine (only for DAC8 modules)

Parameter	Definition
Frequency	Frequency of sine signal in Hz
Phase	Phase of sine signal in degrees
Result channel	Sine signal

Description: A sinusoid voltage signal having the specified frequency and phase is output. The sine signal's amplitude is 10 V. Allowed frequency settings are: 1Hz ... 1000Hz (1 kHz). Allowed phase settings: 0° ... 359° (degrees). The result clock pulse is fixed at 0.1 ms.

The sine signal's period can only be multiples of 0.1ms.

The sine signal is generated with a resolution of 0.1ms. The higher the sine's frequency, the more coarsely the ideal form is approximated. If the signal is analog output, the staircase-shaped signal generated by the DA-converter is slightly filtered (at 5kHz). The resulting curve shape resembles a sine at high frequencies, but at lower frequencies the quality is quite high.

The phase is defined in relationship to other channels created alongside by the module.

Data types:

Result channel
Integer

4.10.58 Slope limiting

Description: Slope-limiting is performed on the input channel's sample values. The maximum difference in value between two consecutive sample values is limited to the maximum increment specified.

Notes: The maximum increment must be specified in terms of the input channel's physical units. If the specified maximum increment is 0, the return value is always the input channel's first sample value.

Data types:

Input channel	Result channel
Integer	Integer

4.10.59 Smoothing based on 2 values

Parameter	Definition
Input channel	Channel to be smoothed
Result channel	Smoothed input channel

Description: The input channel is smoothed by taking the average of 2 consecutive values. The digital filter on which the function is based operates according to the formula:

$$y[k] = (u[k-1] + u[k]) / 2$$

where k is a serial index, u the input channel and y the result channel.

The 1st value in the result channel is set as the 1st sample in the input value.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.60 Smoothing based on 3 values

Parameter	Definition
Input channel	Channel to be smoothed
Result channel	Smoothed input channel

Description: The input channel is smoothed by taking the average of 3 consecutive values. The digital filter on which the function is based operates according to the formula:

$$y[k] = 0.25 * u[k-2] + 0.5 * u[k-1] + 0.25 * u[k]$$

where k is a serial index, u the input channel and y the result channel.

The 1st value in the result channel is set as the 1st sample in the input value. The result channel's 2nd value is set as the average of the input channel's 1st and 2nd values.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.61 Square root

Parameter	Definition
Input channel	Channel containing sample values whose square root is to be taken
Result channel	Square roots of the input channel's values

Description: The square roots of the input channel's sample values are computed. When input channel sample values are negative, the return value is 0.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.62 Standard deviation

Parameter	Definition
Input channel	Channel for which the standard deviation of values within each reduction interval is computed
Result clock pulse	Data rate of the result channel
Result	Sequence of standard deviation values representing each reduction interval in the input channel

Description: The value for the standard deviation is calculated for each reduction interval within the input channel signal. The reduction interval is equal to the result channel's clock pulse rate.

Standard deviation is a statistical quantity characterizing how the data's values are distributed around their arithmetic mean value. Channels whose values don't fluctuate strongly naturally have low values for standard deviation, whereas strongly fluctuating signals have relatively high standard deviations. The algorithm for determining the deviation is as follows:

The deviation of each sample value within the reduction interval is squared and all the squares are summed, divided by the number of values minus 1, and the square root of the result of this is taken.

Notes: The result clock pulse may not exceed the input channel's sampling rate.

Data types:

Input channel	Result channel
Integer or Digital	Integer

4.10.63 Time determination (only for DI16 modules)

Parameter	Definition
Input channel	Channel for whose signal events the time is to be determined
Input range	Maximum measurable time between selected starting and stopping edge 3 s 6 s 12s 25 s 50 s 100 s 3 min 5 min 15 min 30 min 60 min
StartStop	Triggering or stopping of the reading by a positive or negative edge: start pos. edge, stop pos. edge start pos. edge, stop neg. edge start neg. edge, stop pos. edge
Result clock pulse	Data rate of result channel.
Result channel	Channel containing time determination results

Description: Returns the time between two selectable events (Start/Stop) on the digital input channel.

The time between the two edges must not exceed the selected input range. If the time measurement does exceed the limit, the range's endpoint is returned.

If no current counter result can be determined for a result clock pulse interval, the last result is returned again. If multiple time counts are triggered during one result clock pulse interval, the most recent result is returned.

StartStop	Definition
Start pos, Stop pos	The time reading starts upon reception of a positive edge (transition from 0 to 1), and ends upon reception of the next positive edge.
Start pos, Stop neg	The time reading starts upon reception of a positive edge (transition from 0 to 1), and ends upon reception of the next negative edge (transition from 1 to 0).
Start neg, Stop pos	The time reading starts upon reception of a negative edge (transition from 1 to 0), and ends upon reception of the next positive edge (transition from 0 to 1).

Notes: The input range and the module's sampling rate influence the precision of the time measurement.

Only digital input channels are allowed.

The input channel's sampling rate may only be 0.1 ms, 0.2 ms, 0.5 ms or 1 ms. The higher the sampling rate is, the more exactly the time can be determined.

For the most precise frequency measurements, use the incremental encoder module INC4.

Data types:

Input channel	Result channel
Digital	Integer

4.10.64 Triangle (only for DAC8 modules)

Parameter	Definition
Result clock pulse	Data rate of result channel.
No. of clock cycles with positive slopes	How many signal clock cycles are to have positive slopes?
No. of clock cycles with negative slopes	How many signal clock cycles are to have negative slopes?
Maximum amplitude	The maximum signal amplitude in V
Result channel	Triangular signal

Description: Outputs a triangle function at the voltage output. The specified number of clock cycles for the positive slope determines how many cycle durations the signal needs to reach the specified maximum amplitude. The specified number of clock cycles for the negative slope determines how many cycle durations the signal needs to return from the maximum amplitude back to 0 V.

Resulting frequency = 1 / ((No. of cycles with pos. slope + No. of cycles with neg. slope) * clock pulse)

The result clock pulse should be as close to 0.1ms as possible. The higher the pulse rate is, the more accurately the ideal signal shape is approximated. The resulting triangular signal period must not be too short. If the signal is analog output, the staircase-shaped signal generated by the DA-converter is slightly filtered (at 5kHz). The resulting curve shape resembles a triangle at high frequencies and a long signal period.

Data types:

Result channel
Integer

Measurement Technique

5.1 Measurement modes

5.1.1 Bridge modules

With the modules CANSAS-BRIDGE2, -DCB8, -UNI8, µ-CANSAS-B1 or µ-CANSAS-B4 a bridge measurement can be carried out.

5.1.1.1 General remarks

Bridge channels are for taking readings from **measurement bridges** such as resistor bridges or strain gauges. The channels are equipped as **non-isolated differential** amplifiers and can alternatively be used for direct **measurement of voltages**.

There is a distinction among the following operating modes:

1. **Target: Sensor**
   - Full bridge
   - Half bridge
   - Quarter bridge (120Ω)

1. **Target: Strain gauge**
   - Full bridge with 4 active strain gauges in uniaxial direction
   - Full bridge with Poisson strain gauge in adjacent bridge arms
   - Full bridge with Poisson strain gauge in opposing bridge arms
   - Half bridge with one active and one passive strain gauge
   - Half bridge with 2 active strain gauges in uniaxial direction
   - Poisson half bridge
   - Quarter bridge with 120Ω strain gauge

☞ **Note**

The following discussion, whenever it is in reference to terminal connections, circuitry etc., pertains only to the CANSAS-BRIDGE2 module, and only the most general remarks on bridge measurement are applicable for bridge measurement systems besides UNI8 and DCB8. Such generalized topics include instrument sensitivity and strain gauge properties.

5.1.2 Bridge measurements with wire strain gauges (WSGs)

When connecting, observe the notes contained in the sections headed by "Block diagram" and "DC-Bridge measurement (measurement target: Sensor)".

In the context of bridge amplifiers, strain analysis plays a major role. The configuration of a CANSAS BRIDGE2 bridge module takes full account of this fact.

Strain in this sense refers to the ratio of a body's original length to the change in length due to a force exerted upon it.

$$\varepsilon = \frac{dL}{L}$$

By selecting "Strain gauge" as the measurement target on the virtual index card "Inputs", common bridge circuits and configurations for wire strain gauges (WSG) are offered for selection. The scaling can be adjusted in terms of typical parameters for strain measurements such as the gauge factor or Poisson's ratio, the transversal expansion coefficient.

If a WSG adheres to a test object, the strain on the object is transmitted to the bridge circuit. The changes in the lengths of the bridge arms causes their impedances to change. There is a correlation between the changes in length and the changes in resistance:

$$\varepsilon = \frac{dL}{L} = \frac{dR / R}{k}$$

ε : strain

dL : *change in length*
L : *original length*
dR : *change in resistance*
R : *resistance of strain gauge*

k : *Gauge factor, describing the ratio of relative length change to change in resistance*

The changes in resistance caused by the strain are very small. For this reason, a bridge circuit is used to translate these changes into voltage changes. Depending on the circuit, from one to four WSGs can be employed as bridge resistors.

Assuming that all bridge resistors have the same value, we have

$$Ua = Ue * \frac{dR}{4*R} = \frac{Ue}{4} * k * \varepsilon$$

Ua : measurement voltage

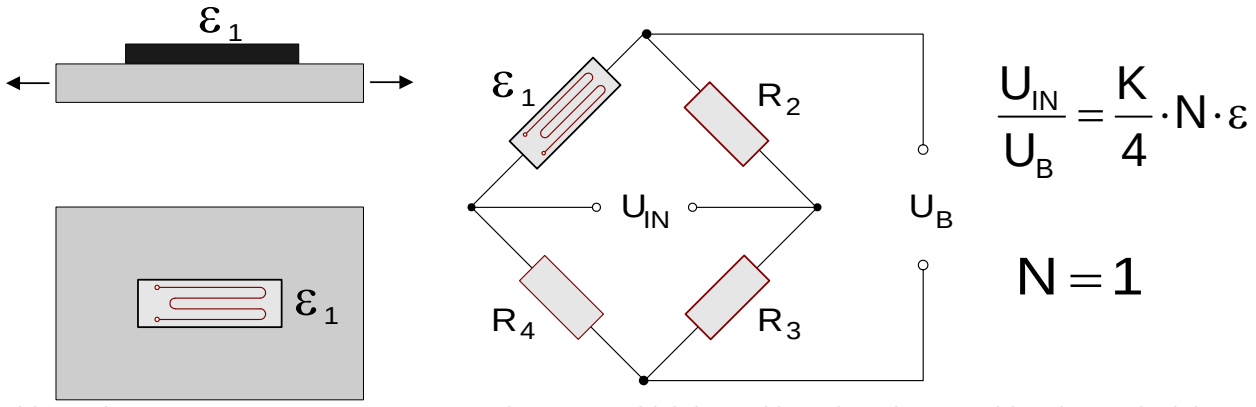
Ue : excitation voltage

$$\varepsilon = \frac{Ua * 4}{Ue * k}$$

For concrete measurement tasks, the arrangement of the WSGs on the test object is important, as well as the circuitry of the bridge. On the card "Bridge circuit", you can select from among typical arrangements. A graphic shows the position on the test object and the bridge circuitry. Notes on the selected arrangement are displayed in the text box beneath.

5.1.2.1 Selectable geometric arrangements for wire strain gauges and the bridge circuits applied:

5.1.2.1.1 Quarter bridge for 120 Ohm WSG



$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 1$$

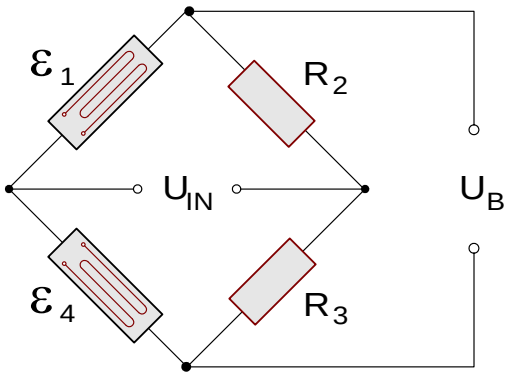
This strain gauge arrangement uses an active WSG which is positioned on the test object in a uniaxial stress field. This WSG is joined by 3 passive resistors within the CANSAS module to form a full bridge. The strain gauge can have a resistance value of 120Ω.

This arrangement does not come with temperature compensation. The strain is computed as:

$$\varepsilon[\frac{\mu m}{m}] = \frac{4 * 1000}{k} * \frac{Ua}{Ue} \; [\frac{mV}{V}]$$

k: gauge factor

5.1.2.1.2 General half bridge

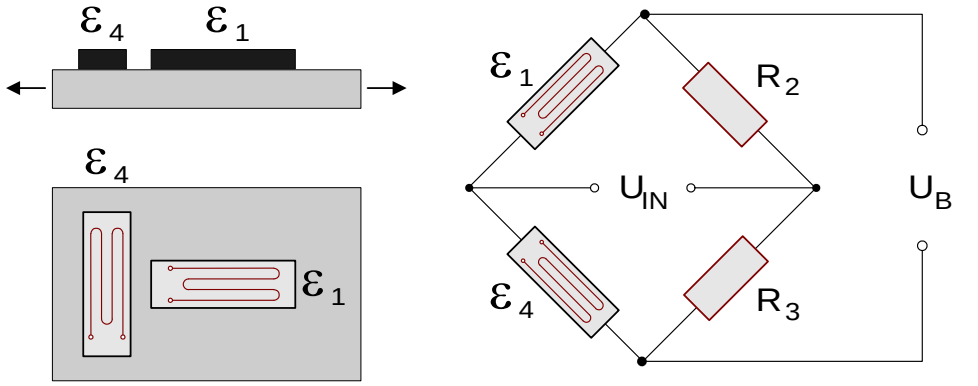


$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 1, 2, 4, 1-\upsilon, 1+\upsilon$$

General half bridge with bridge completion in measurement device. N has to be set from a list.

5.1.2.1.3 Poisson half bridge



$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 1 + \upsilon$$

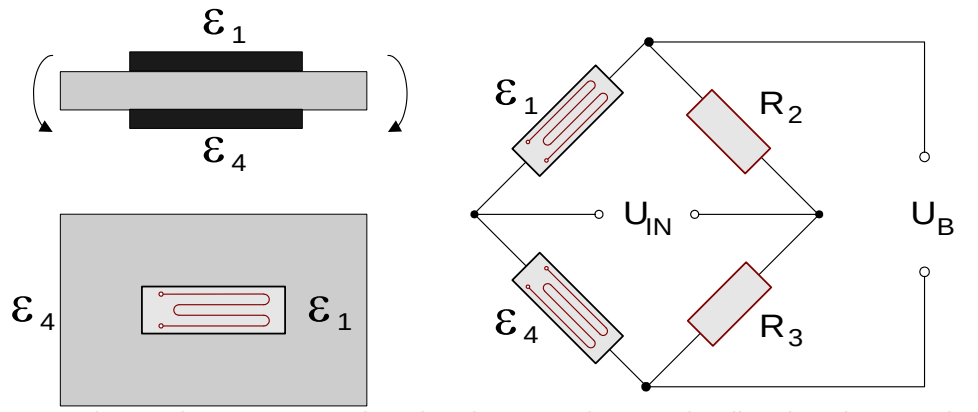
In this circuit, 2 active WSGs are used. The WSG is positioned transverse to the main direction of strain. The transversal contraction is exploited. For this reason, the Poisson's ratio for the material, which is its transversal expansion coefficient, must be supplied along with the gauge factor. This circuit offers good temperature compensation. The strain is computed as:

$$\varepsilon[\frac{\mu m}{m}] = \frac{4 * 1000}{k * (1 + \nu)} * \frac{Ua}{Ue} \quad [\frac{mV}{V}]$$

k: gauge factor

ν: Poisson's ratio of test object material

5.1.2.1.4 Half bridge with two active strain gauges in uniaxial direction



$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

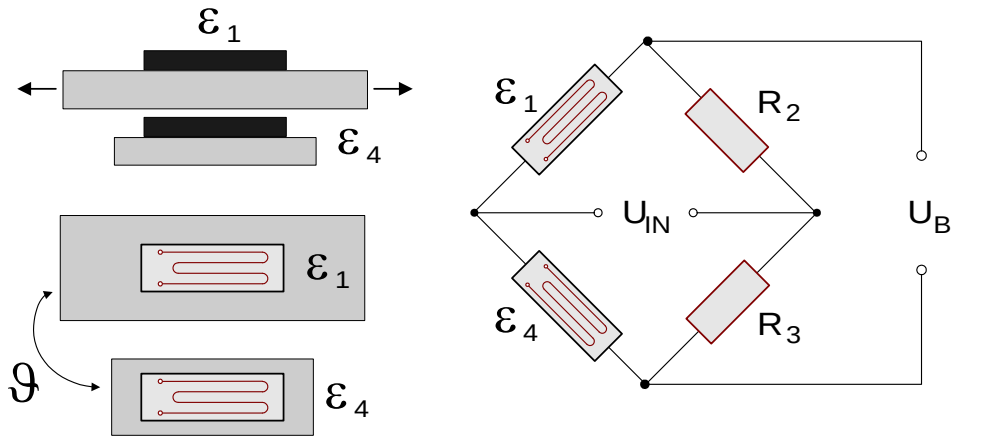
$$N = 2$$

Two active strain gauges are placed under stress in opposite directions but equal magnitude, i.e. one strain gauge is under compression and another under equal tension. (bending beam circuit). This arrangement doubles the measurement's sensitivity to a bending moment. On the other hand, longitudinal force, torque and temperature are all compensated for. The strain is computed as:

$$\varepsilon[\frac{\mu m}{m}] = \frac{4 * 1000}{2 * k} * \frac{Ua}{Ue} \quad [\frac{mV}{V}]$$

k: gauge factor

5.1.2.1.5 Half bridges with one active and one passive strain gauge



$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

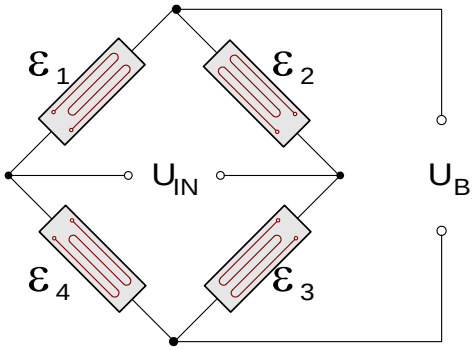
$$N = 1$$

This circuit involves WSGs. The first one is positioned on the test object, the second on a sample of the same material under the same ambient temperature and serves the purpose of temperature compensation. The strain is computed as:

$$\varepsilon[\frac{\mu m}{m}] = \frac{4 * 1000}{k} * \frac{Ua}{Ue} \; [\frac{mV}{V}]$$

k: gauge factor

5.1.2.1.6 General Full bridge

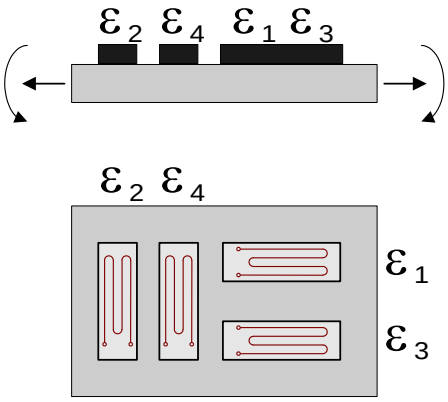


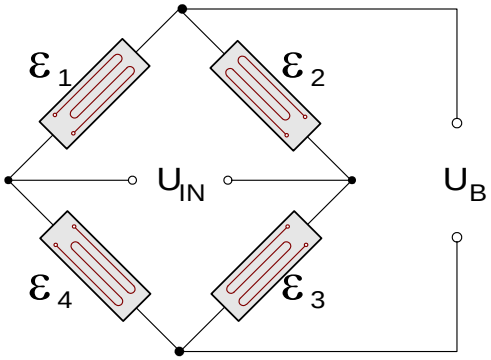
$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 1, 2, 1-\upsilon, 1+\upsilon, 2(1-\upsilon), 2(1+\upsilon)$$

General full bridge. N has to be set from a list.

5.1.2.1.7 Full bridge with Poisson strain gauges in opposed branches





$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 2 \cdot (1 + \upsilon)$$

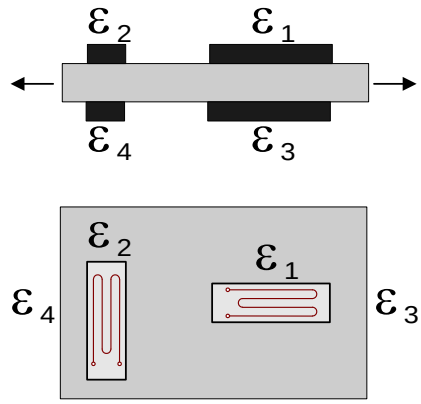
Two active WSGs are positioned along the longitudinal strain and are joined by two transversally positioned WSGs to complete the bridge (torsion bar arrangement). In the bridge, the longitudinal strain gauges are located in opposite branches. This circuit provides better exploitation of transversal contraction and longitudinal force as well as good temperature compensation. In this arrangement, the transversal expansion coefficient must be specified. The strain is computed as:

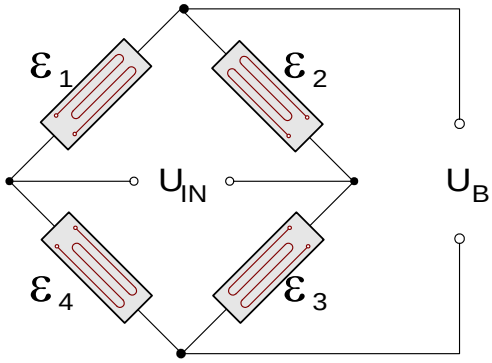
$$\varepsilon[\frac{\mu}{m}] = \frac{4*1000}{2*k*(1+\nu)} * \frac{Ua}{Ue} \quad [\frac{mV}{V}]$$

k: gauge factor

ν: Poisson's ratio of test object material

5.1.2.1.8 Full bridge with Poisson strain gauges in adjacent branches





$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 2 \cdot (1 + \upsilon)$$

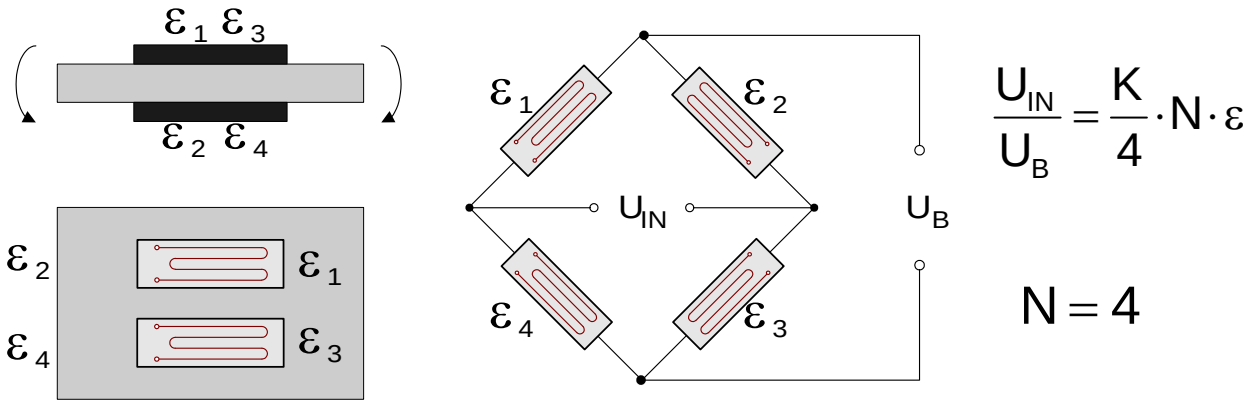
Two active WSGs are positioned along the main direction of strain. These two are completed with two transversally positioned WSGs. In the bridge, the two longitudinal strain gauges are in adjacent bridge arms. This circuit offers improved sensitivity to the moment of bending and simultaneously compensates longitudinal force, torque and temperature.

$$\varepsilon[\frac{\mu}{m}] = \frac{4*1000}{2*k*(1-\nu)} * \frac{Ua}{Ue} \quad [\frac{mV}{V}]$$

k: gauge factor

ν: Poisson's ratio of test object material

5.1.2.1.9 Full bridge with 4 active strain gauges in uniaxial direction



$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

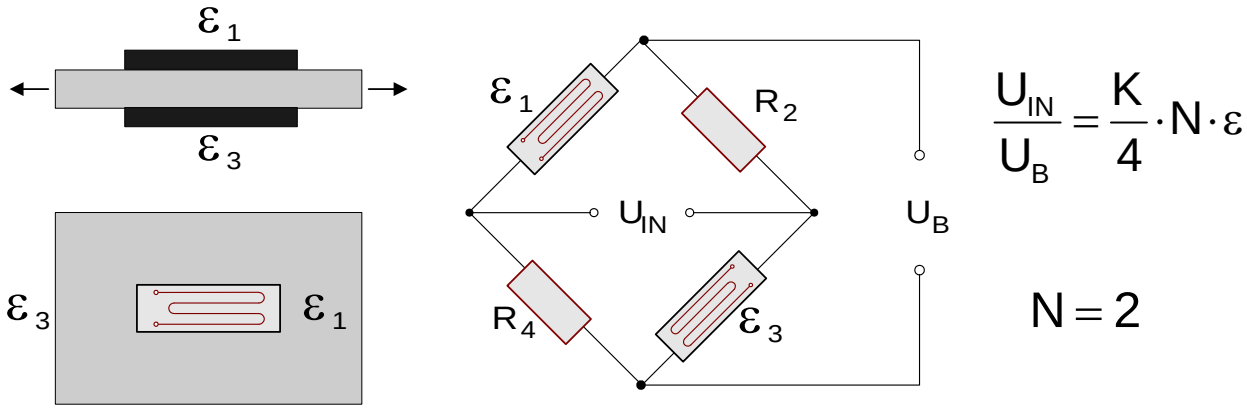
$$N = 4$$

The circuit consists of 4 active WSGs. Two are under compression and the others under equal tension. The strain gauges under tension are positioned in opposite bridge arms. The sensitivity to the moment of bending is increased. At the same time, longitudinal force, torque and temperature are compensated. The strain is computed as:

$$\varepsilon[\frac{\mu m}{m}] = \frac{4 * 1000}{4 * k} * \frac{Ua}{Ue} \; [\frac{mV}{V}]$$

k: gauge factor

5.1.2.1.10 Full bridge (Half bridge-shear strain) opposite arms two active strain gauges



$$\frac{U_{IN}}{U_B} = \frac{K}{4} \cdot N \cdot \varepsilon$$

$$N = 2$$

Two active strain gauges are placed under stress in equal magnitude. For measurement of tension and compression (non-linear) to eliminate bending. Temperature gradient should be small. The strain is computed as:

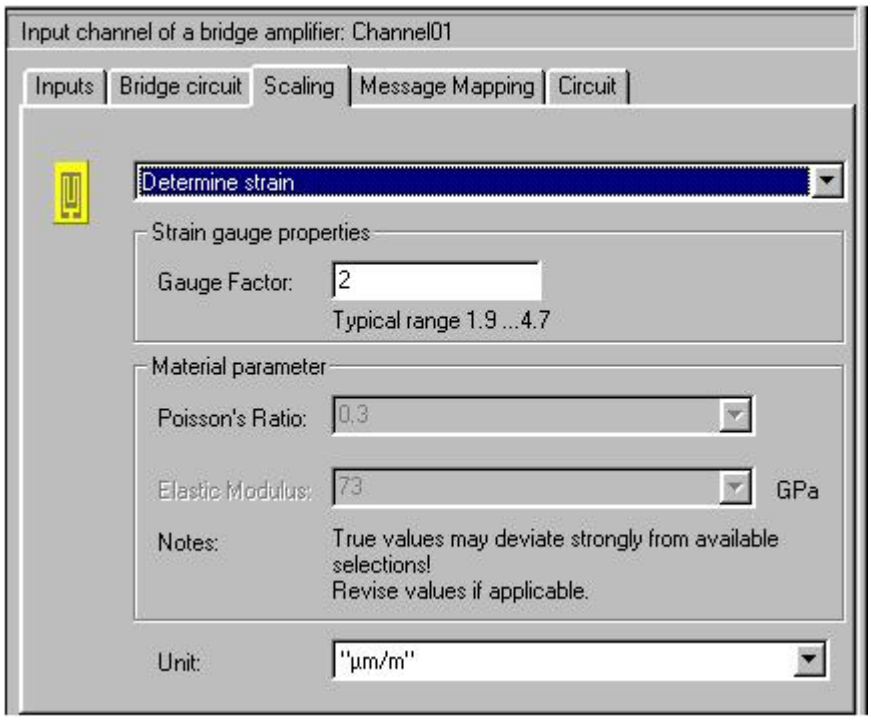
$$\varepsilon[\frac{\mu m}{m}] = \frac{4 * 1000}{2 * k} * \frac{Ua}{Ue} \; [\frac{mV}{V}]$$

k: gauge factor

5.1.2.1.11 Scaling for the strain analysis

It is possible to choose whether to determine the strain or the mechanical stress suffered by the part. In the range of elastic deformation, the axial stress (force / cross section) is proportional to the strain. The proportionality factor is the modulus of elasticity.

Mechanical stress = modulus of elasticity * strain (Hooke's law)



K-factor: The K-factor is the ratio by which the mechanical quantity (elongation) is transformed to the electrical quantity (change in resistance). The typical range is between 1,9 and 4,7. The exact value can be found in the spec sheet for the WSG used. If the value entered for this parameter is outside of this range, a warning message will appear but the CANSAS module can still be configured.

Poisson's ratio: If a body suffers compression or tension and is able to be freely deformed, then not only its length but also its thickness changes. This phenomenon is known as transversal contraction. It can be shown that for each kind of material, the relative change in length is proportional to the relative change in thickness D. The transversal elongation coefficient (Poisson's ratio) is the material-dependent proportionality factor. The material constant is in the range 0,2 to 0,5.

In bridge circuits where the WSGs are positioned transversally to the main direction of strain, this constant must be supplied by the user. The ratios for various materials are accessible in the list box. These values are only for orientation and may need to be adjusted.

Elastic modulus: The elastic modulus E, is a material parameter characterizing how a body is deformed under the action of pressure or tension in the direction of the force. The unit for E is N/mm^2. This value must be entered for the mechanical stress to be determined The e-moduli for various materials are accessible in the list box. These values are only for orientation and may need to be adjusted.

Unit: When the strain is determined, the readings appear with the unit µm/m. For the mechanical stress one can toggle between MPa and N/mm^2. 1 GPa = 10^3 N/mm^2

Note that the elastic modulus is always in GPa.

5.1.2.2 Bridge balancing

A significant characteristic of bridge measurements is the fact that the actual measurement signal is attended by an offset which can be **multiples of the input range**. Measurement bridges, consisting for instance of wire strain gauges (WSGs), respond to minuscule changes in their components' resistance (in the µV/V = ppm = parts-per-million = 1E-6 range). The static initial asymmetry (offset) due to production tolerances or assemble conditions of the components, by comparison, can be in the range of mV/V, in other words in the range of the total input range or even multiples of it.

Since the offset also depends on the sensor connected it can't be calibrated for the device but must be balanced **“online”, before starting the measurement**. The precondition for this is that the sensor used must be set up in the system the same way for the balancing as for the measurement and **may not be stimulated dynamically**.

5.1.3 Incremental encoders

General notes

CANSAS-INC4's 4 incremental encoder channels are for the capture of signals representing **time or frequency data**. In contrast to conventional analog and digital input channels, the input is not sampled at fixed intervals, instead, the (variable) time intervals between transitions to previously defined signal states are measured by means of a counting apparatus.

The **counters** used by CANSAS-INC4 (for each of the 4 channels separately) can have a time resolution of up to 31ns (32M Hz) which is more precise than what the **sampling-method** can achieve (at comparable expense). The so-called "sampling time" which one sets for the incremental encoder channels therefore refers to the rate at which the result data from the digital counter, which may be frequency or velocity data etc., are called by the system. The CANSAS-INC4 hardware and the algorithm employed ensure that no sensor impulse is discarded or ignored.

CANSAS-INC4 allows **time, event and frequency readings** with specifiable resolution and accuracy over a large dynamic range. The incremental encoder interface serves to compile such digital events and the time intervals between them and the frequencies of their occurrence.

5.1.3.1 Connections

Notes on the channels:

- The module comprises 4 encoders. Each encoder is connected to one channel which in turn can be connected to the CAN-bus.
- Each encoder has 2 input signals: an X and a Y-track
- Each input signal is measured differentially, so it occupies 2 pins in the terminal.

Each of the 4 incremental encoder channels has an **X and a Y-track** for connecting a two-signal encoder. If a one-signal encoder is used, it must be connected to the X-track and the positive Y-track must be shorted with the negative Y-track. If the index-input isn't used, the positive index channel must be shorted with the negative index-channel.

Although the measurement is differential, the input voltage at any of the input pins may not deviate by more than +10 V or -10 V from the module's reference ground. Otherwise the input amplifier reaches saturation which can only be reversed after a long time. The differential voltage itself may only be between -10 V and +10 V. A greater input voltage (maximum ± 50 V to Chassis) can lead to displacement of the threshold or hysteresis and thus to undesired results. Another effect of the input circuit's saturation behavior is a switching delay which could corrupt the measurement results.

The inputs are not isolated from each other. They are referenced to the module's ground (housing, Chassis, Ground). There is a ground terminal provided in the connection plug (in addition to the ground for the built-in sensor supply voltage).

A reference ground between the encoders and the CANSAS module may have to be established, as well, even for differential measurements.

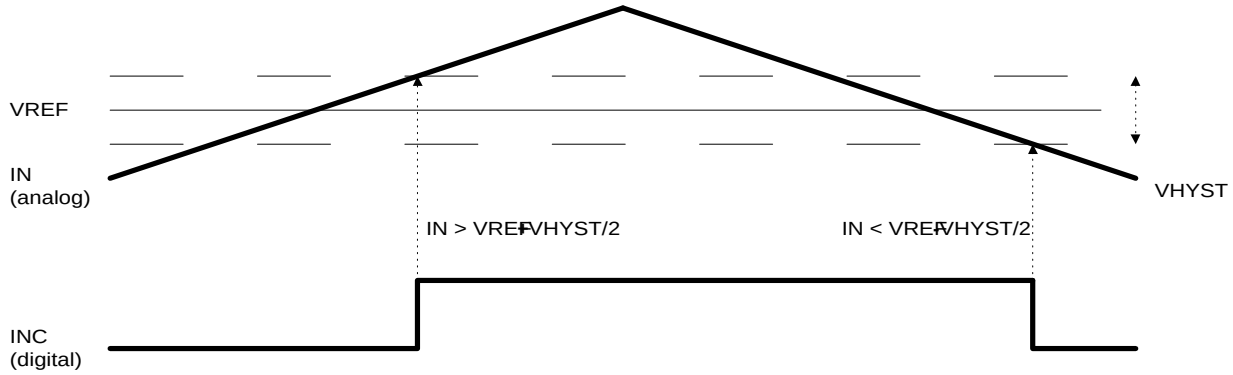
Please observe the notes below under the heading "Block diagram 166".

5.1.3.2 Comparator conditioning

The incremental encoders' special properties make **special demands for signal quality**: the very high resolution offered by the detector or counter means that even very short impulses can be captured and evaluated, which sampling-based measurement methods (such as for the digital inputs of the DI16 module) would not (or almost never) be able to detect. Therefore, the digital signals must have clear edges in order not to produce disturbed readings. Spurious impulses or contact bouncing can lead to artifacts such as enormous peaks in RPM-signals etc..

Simple sensors working on the principles of induction or photoelectric relays often emit unconditioned analog signals which must be evaluated according to a threshold condition. Aside from that, problems can occur even with conditioned encoder signals (e.g. TTL-levels) due to long cables, bad reference voltages, ground loops or interference. CANSAS-INC4 is able to counteract these problems thanks to a special 3-stage conditioning unit:

First comes a high-impedance **differential amplifier** (± 10 V range, 100kΩ) which enables reliable acquisition from a sensor even over a long cable as well as effective suppression of common mode interference and ground loops. Next, a (configurable) **smoothing filter** offers additional interference suppression adapted to the measurement situation. Lastly, a **comparator** with adjustable threshold and hysteresis serves as a digital detector. The (adjustable) **hysteresis** also serves to suppress interference:

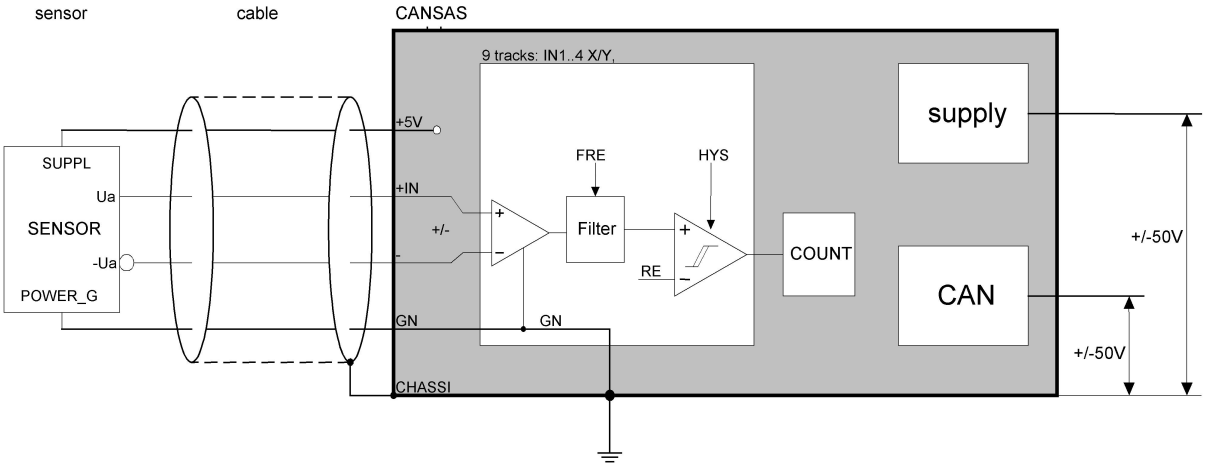


If the analog signal exceeds the threshold ***VREF + VHYST/2***, the digital signal changes its state (: 0 ⇒ 1) and simultaneously reduces the threshold which the signal must fall below in order for the state to return to 0 by the amount VHYST. Thus, the threshold for the next state transition from 1 to 0 is ***VREF – VHYST/2.*** The size of the hysteresis represents the width of a range-band inside of which the signal can fluctuate (due to signal noise and interference) without an impulse being recorded.

Ranges:

- VREF (Threshold) = -10 V .. +10V
- VHYST (Hysteresis) = +100 mV...+4V
- Low pass filter: None, 20 kHz, 2 kHz, 200 Hz

5.1.3.3 Block diagram



Note

- It is not sufficient to connect a differential voltage between +INX and -INX. The operational amplifier only works correctly if its reference ground (GND) is not floating but is grounded.
- A reference ground must be established in the measurement chain. There are various techniques as well as considerations. In some arrangements, grounding the sensor is preferred, in others grounding the measurement system (CANSAS chassis). Either way, ground loops must be avoided.
- Grounding is also recommended as a way of avoiding the buildup of high or dangerous potential differences between exposed conducting parts (such as the chassis) and ground.
- If the sensor does not make Power_Gnd and -Ua separately accessible, then they must be considered connected at the sensor. In that case that is simply the ground connection.

5.1.3.4 Single-signal/ Two-signal

The **single signal counter** returns a simple pulse sequence. This means that the pulse count and the time between pulses can be determined, but not the rotation direction of the incremental counter.

A **two signal encoder** returns two pulse sequences with a 90° offset. Along with the pulse frequency, the rotation direction can also be indicated as positive or negative. A measurement with two-signal counters is selected in the combobox “Measurement mode” together with the desired operation type.

5.1.3.5 Zero pulse (index)

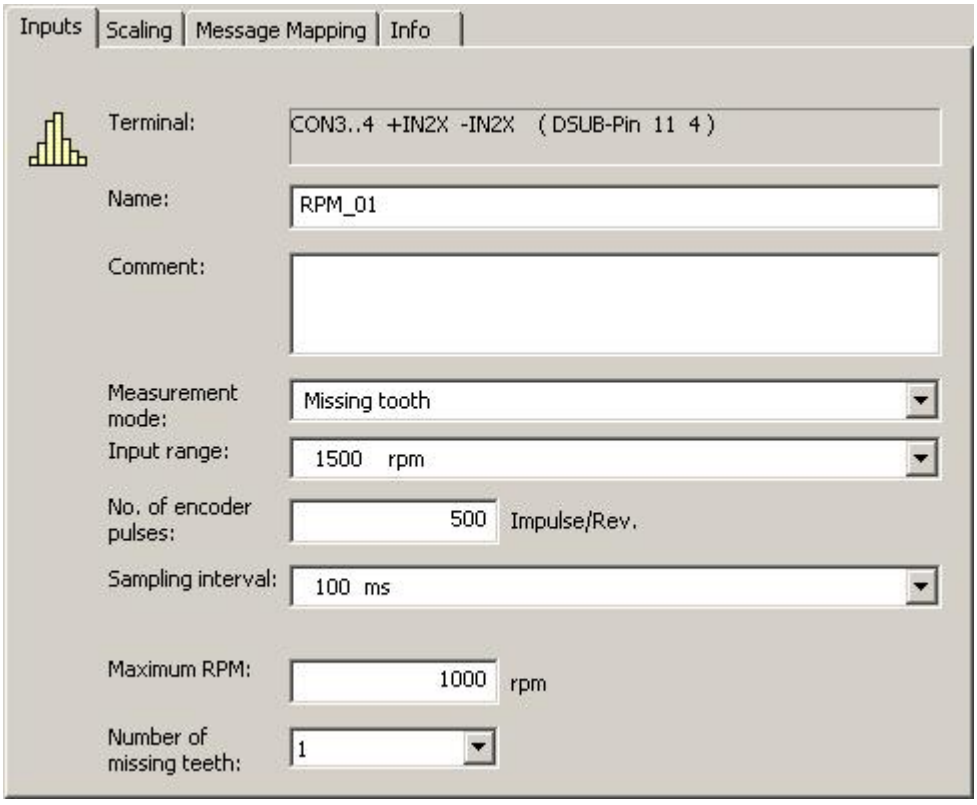
The **zero pulse** starts the INC4 channels' counter mechanism. This means the measured values are only recorded if an event occurs at the **index-channel**. If measurement without a zero pulse is selected, the measurement starts directly upon activation of the CANSAS-INC4.

Notes

- **The system only takes the zero pulse into account following configuration or after starting the INC4 module. Restarting the measurement does not cause a reset.**
- If the zero pulse fails to appear, the INC4 does not start measurement at all. In that case, the channels only return zero.
- The index channel only applies to all four channels of the module.

5.1.3.6 Missing tooth

As of CANSAS Version 1.6R6, a new measurement mode, ***Missing tooth***, is available for INC4 modules (as of motherboard 2).



This mode is suited to incremental counters which have one or two missing teeth per revolution for the purpose of angle recognition. The sensor then returns instead of 60 pulses/rev only 58. Such a sensor connected to the INC4 indicates messy dips in the rotation speed if the missing cogs do not return any pulse. This is avoided by means of the *Missing tooth* measurement mode, since this mode detects the missing cogs and interpolates around the apparent dip.

☞ **Note**

- When the measurement mode *Missing tooth* is set for a channel, then the only measurement mode options left for al other channels are: ***Velocity, Frequency, RPMs***

5.1.3.7 Event counting, angle and displacement measurement

The quantities derived from **event counting**, (i.e. events, displacement and angle) can be measured either "differentially" or "cumulatively".

In **"differential" measurement**, the return value is the **change** in displacement or angle (positive, or negative for two-signal encoders), or all new events (always positive) acquired in the course of the last sampling interval.

In **"cumulative" measurement**, the return value is the **sum** of all displacement or angle changes, or of all event which occurred.

The event counter counts the sensor pulses which occur during a single time interval (differential event counting) or the sum of all events (cumulative event counting). The interval corresponds to the sampling time set by the user. The maximum event frequency is about 500 kHz.

An event is a positive edge in the measurement signal which exceeds the user-set threshold value.

The derivative quantities displacement and angle measurement have the following settings:

- Choice of one-signal and two-signal encoder 166
- Start of measurement with or without "Zero impulse" 166
- Number of pulses (per unit)

Setting the number of pulses:
IncrementalEncoder0x at Index card "Inputs" à Combo box "No. of encoder pulses"

The number of pulses may be between 1 and 999999.

To obtain the greatest accuracy for CANSAS-INC4 measurement results over a wide dynamic range, it is recommended to select an appropriate **input range** for the task.

Setting the input range:
IncrementalEncoder0x at *Index card "Inputs"* → *Combo box "Input range"*

Note that the input range can be expressed in terms of a different physical quantity than the measurement quantity. For instance, for event counting the input range is expressed as a frequency.

The input range selected states the **input range end value**. **The highest frequency contained in the measured signal may not exceed this end value**. If this maximum frequency is exceeded during measurement, the system returns the input range end value at the points where the signal is out of bounds. The input ranges depend on the sampling interval selected and under some circumstances on the number of encoder pulses.

5.1.3.7.1 Resetting of summation

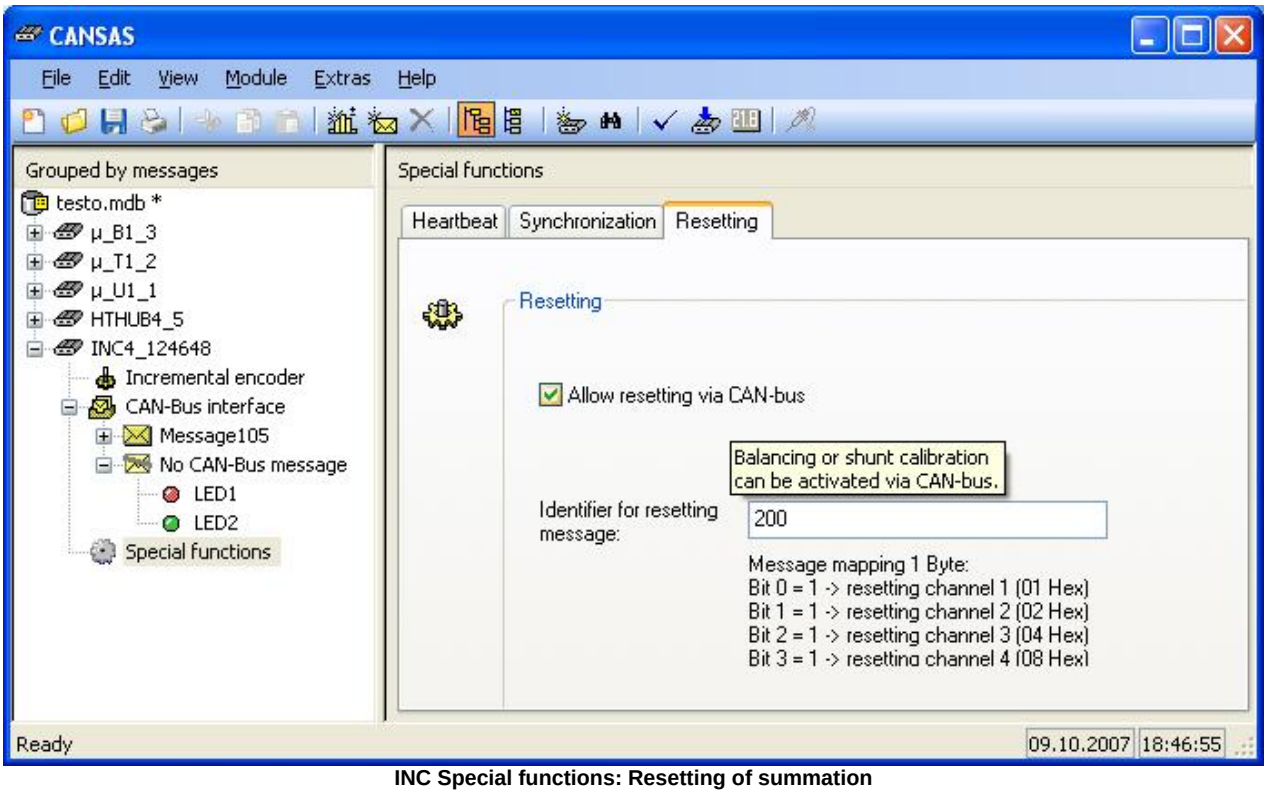
With the measurement modes involving summation (events, angle and displacement), it is possible to reset the sum to zero during a running measurement. This can be accomplished in either of two ways:

- *Measure* dialog*:* The reset command from the channel menu is used to manually reset all selected incremental counter channels.
- Special Functions node: On the *Resetting* page, it is possible to enable separate resetting of each channel by means of a CAN-Bus message.

Manual resetting by means of Measure dialog

Manual resetting of summation by means of Measure dialog

Resetting the summation by means of a CAN-bus message



INC Special functions: Resetting of summation

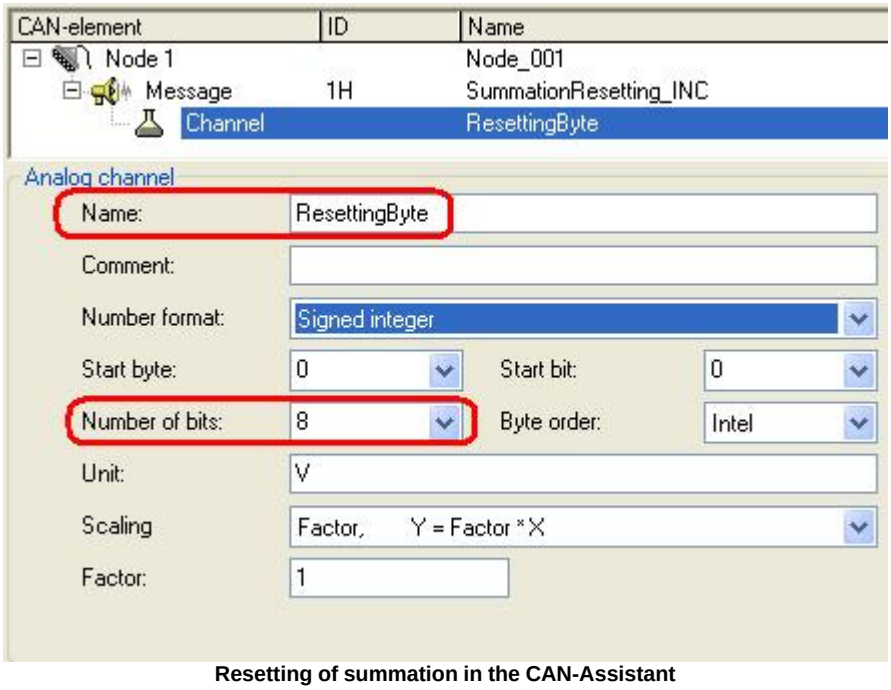
This dialog enables resetting of the summations of individual incremental counter channels.

The message identifier is set for all channels jointly. The respective channel is determined on the basis of the bit in the sent message's data byte:

Example:

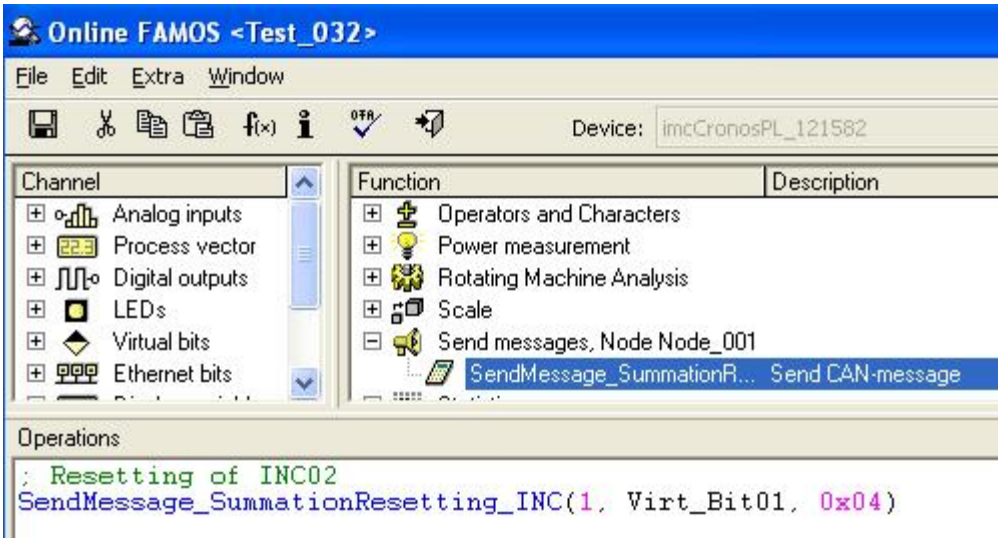
Identifier for reset-message = 200, Channel 2 is to be reset.

1. Create the message to be sent in the CAN-Assistant. A message having one data byte is required. Give a distinct name to this message. Then assign a channel to it. Since only one data byte is available, this channel's length can not exceed 8 bits. All other settings play no role at this point.



Resetting of summation in the CAN-Assistant

2. Online FAMOS (imcDevices) sends a message if the virtual bit Bit01 is set. In this message, the value 0x04H is set to INC4 and resets the value of the incremental counter channel 02.



Resetting of summation in OnlineFAMOS

5.1.3.8 Time measurement

The time measurement mode allows the definition of **edge conditions** between which the time interval is to be measured.

The following combinations are possible:

	Start measurement upon	Input	Stop measurement upon	Input
1.	positive edge	X-track	positive edge	X- track
2.	positive edge	X- track	negative edge	X- track
3,	negative edge	X- track	positive edge	X- track
4.	negative edge	X- track	negative edge	X- track
5.	positive edge	X- track	positive edge	Y- track
6.	positive edge	X- track	negative edge	Y- track

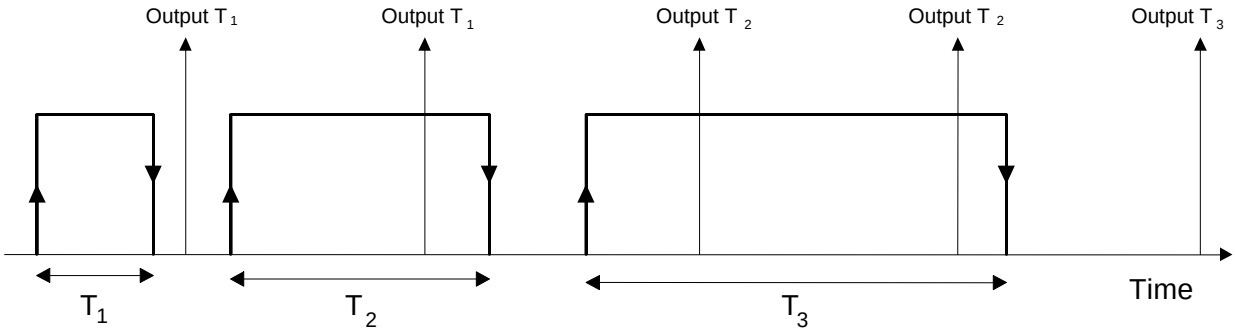
To ensure a high time resolution for the measurement results, suitable scaling must be set for the measurement. An **input range** specifies the maximum time interval which can be measured between the selected starting and stopping edge. **The time between the signal edges may not be greater than the selected input range.** If the maximum time interval is exceeded during measurement, the system returns the input value range end instead of the true measured value.

Setting the input range:
IncrementalEncoder0x → Index card "Inputs" → Combo box "Input range"

Input range	Time resolution	Input range	Time resolution
1 ms	31,25ns	250 ms	8us
2 ms	62,50ns	500 ms	16us
4 ms	125,00ns	1s	32us
8 ms	250,00ns	2s	64us
16 ms	500,00ns	4s	128us
30 ms	1us	8s	256us
60 ms	2us	16s	512us
120 ms	4us	30s	1024 ms

The time resolution corresponds to the value of an LSB (Least Significant Bit).

During sampling intervals when no time measurement was possible (because either a starting or stopping edge was missing), the last valid return value continues to be returned until a time measurement is completed. If there is no valid return value, zero is returned. If more than one time measurement is completed during a single sampling interval (due to multiple starting and stopping edges), the last time measured is returned.



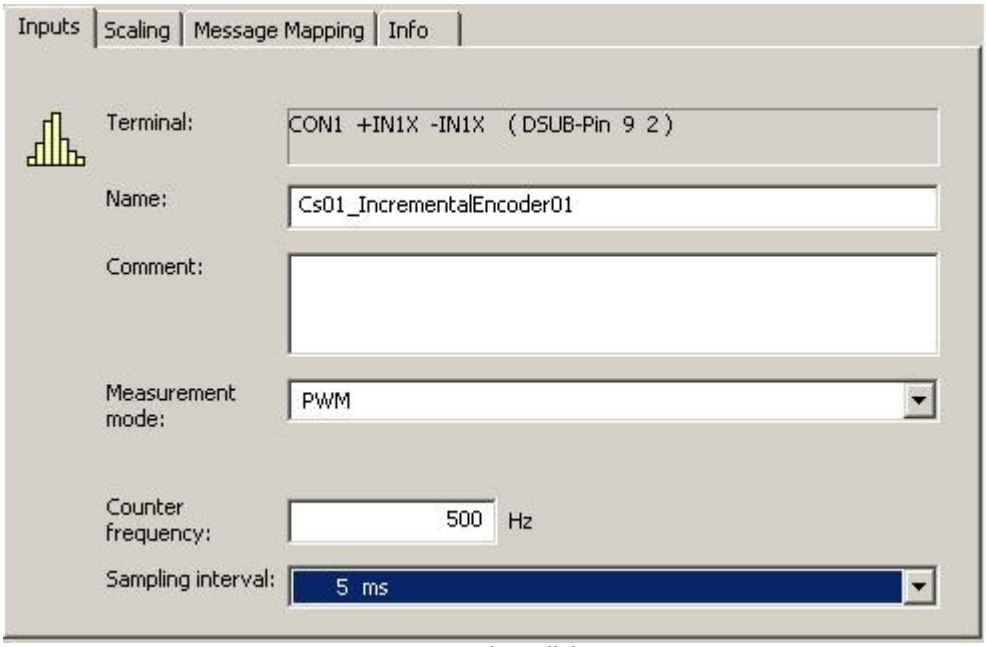
Above is illustrated a measured signal from which time readings are taken. Each reading starts at a positive edge in the signal and is stopped at a negative edge. The "up" arrows indicate the times at which the system returns a result. The returned values in this case are T1 –twice; T2 –twice; and T3,

5.1.3.9 PWM

Pulse width modulation (PWM) is a type of modulation in which a technical variable (e.g. electrical current) switches between two values. In the process, the **duty cycle ratio is modulated at constant frequency**.

PWM is also known as pulse duration modulation (PDM).

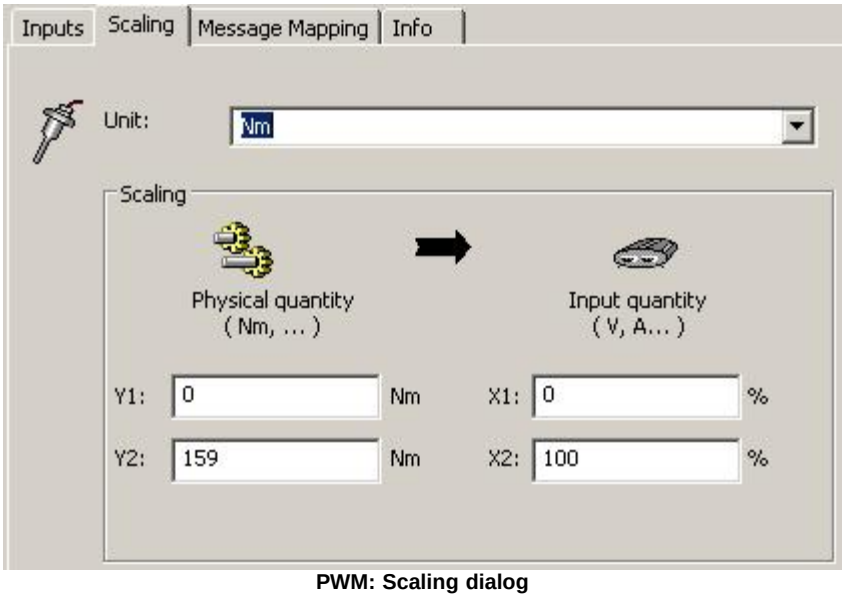
A good illustration of this modulation type would be a switch used to continually switch a heater on and off. The higher the ratio of the on-time to the off-time, the higher the average heating power is.



PWM settings dialog

Give the PWM emitter a fixed frequency. As part of PWM measurement, a time measurement is carried out. In every sampling interval, the duration from the first increasing slope to the next decreasing slope is determined. This pulse duration is compared to the period duration, resulting in a value between 0 and 100%.

On the Scaling page, you set how the percent value is interpreted:



PWM: Scaling dialog

Example:

Counter frequency: 500 Hz , sampling interval: 5 ms, 100% corresponds to 159Nm

At a pulse duration of 250µs, the following values result:

250µs *5001/s*100%= 12,5%

Indicated value = 12,5% x 159Nm/100%= 19,86Nm

The result is updated every 5 ms.

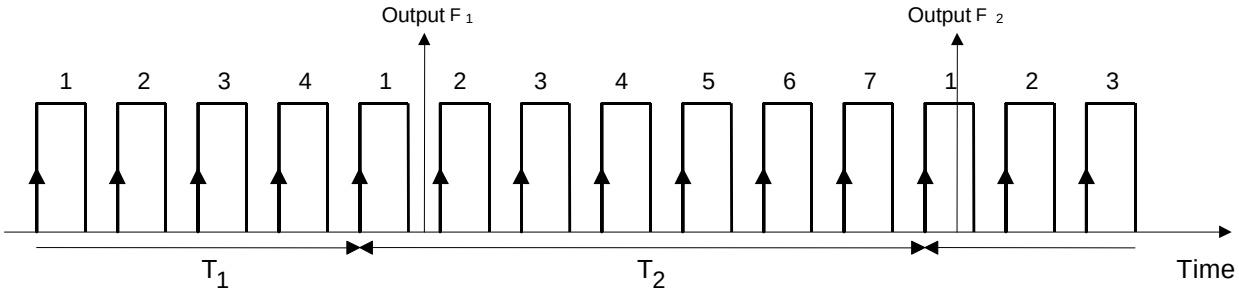
☞ **Notes**

- Correct indication of the counter frequency is absolutely necessary for this procedure.

- There is exactly one pulse time measurement per sampling interval. Change of the pulse times within one sampling interval, called jitter, is not recognized. If you record the data with an imc device, you can smooth the signal, averaging out the jitter by selecting the CANSAS channel's sampling rate to be as close as possible to the counter frequency. Then use Online FAMOS to smooth out the data stream.
- If the sampling interval is set to be faster than the counter frequency, the most recent result is outputted repeatedly.

5.1.3.10 Measurements of frequency, RPMs and velocity

Determining a frequency and the derivative quantities RPM and velocity is based on the **combination of event counting and time measurement**. In other words, during a sampling interval, the number of events occurring as well as the time interval between the first and last event is measured.



The frequency is determined as the number of events counted divided by the time between the first and the last "complete" event in the interval. An event is complete when a positive edge is succeeded by a subsequent positive edge.

The frequencies to be measured by CANSAS-INC4 must lie within the range 30m Hz < f < 450 kHz. If the maximum frequency is exceeded during a measurement, the system returns the input range end value instead of the true measured values.

The derivative quantities RPM and velocity measurement have the following settings:

- Choice of one-signal and two-signal encoder 166
- Start of measurement with or without "Zero impulse" 166
- Number of pulses (per unit)

The frequency resolution of the measurement results depends on the input range selected.

Setting the input range:
IncrementalEncoder0x → Index card "Inputs" → Combo box "Input range"

Input ranges and the corresponding frequency resolutions			
Input range	**Frequency resolution**	**Input range**	**Frequency resolution**
450 kHz	15.2588 Hz	3 kHz	119.2m Hz
200 kHz	7.6294 Hz	1.5 kHz	59.6m Hz
100 kHz	3.8417 Hz	750 Hz	29.8m Hz
50 kHz	1.907 Hz	450 Hz	14.9m Hz
25 kHz	0.9537 Hz	200 Hz	7.45m Hz
12,5 kHz	0.4768 Hz	100 Hz	3.73m Hz
7 kHz	0.2384 Hz	50 Hz	1.86m Hz

The input ranges and resolutions for the RPM or velocity also depend on the number of encoder pulses set. If the number of pulses is known, the RPM and velocity values can easily be computed using the above table according to:

RPM:
Input range = ([Frequency input range in Hz] * 60 / [Encoder pulses per revolution]) in RPM
Resolution = ([Frequency resolution in Hz] * 60 / [Encoder pulses per revolution]) in RPM

☞ **Note**

If you use a counter which indicates this zero position by a missing cog, you will avoid seeing gaps in the signal by means of the measurement modeMissing tooth 167.

Velocity:
Input range = ([Frequency input range in Hz] / [Encoder pulses per m]) in m/s
Resolution = ([Frequency resolution in Hz] / [Encoder pulses per m]) in m/s

Setting the number of pulses:
IncrementalEncoder0x → Index card "Inputs" → Combo box "No. of encoder pulses"

The number of encoder pulses must be between 1 and 999999.

The input range selected states the **input range end value**. **The highest frequency/RPM-value/velocity contained in the measured signal may not exceed this end value**. The **sampling interval** can take discrete values between 1 ms and 1 min and states the rate at which result values are returned.

Setting the sampling interval:
IncrementalEncoder0x → Index card "Inputs" → Combo box "Sampling interval"

5.1.3.11 Data types

All measurement values are expressed in the data format "16 bit signed integer". The measurement values can be positioned in CAN-bus messages in precisely this format. Calculations for virtual channels are also carried out in this format.

The only exceptions are the cumulative measurement quantities (cumulative events, angle or displacement) accrued since the start of a measurement. In CANSAS, a measurement starts directly after the module is configured or activated. For the cumulative measurement quantities, the data type "32 bit signed integer" is used. In this case, the differential readings taken (such as: events within the last sampling interval) are totaled up. The 32-bit value can overflow. This must be noted when evaluating a CAN-message of this type. Then, the 32-bit value cannot be used for subsequent processing, but can only serve as an output on the CAN-bus.

5.1.4 Digital Inputs

The switching thresholds can be toggled between TTL and 24 V range.

The switching thresholds are:

	TTL- range	24 V range
Lower threshold	0,8V	5,0V
Upper threshold	2,0V	8,0V

5.1.5 Digital Outputs (CANSAS-DO8R, -DO16, -DO16R)

These modules are for digital output. The CANSAS-DO16R module has 16 digital outputs, which are switched using relais. DO16 (without "R") serves the same purpose with open collector outputs. The CANSAS-DO8R module has 8 relay switches. The output signals can be set by a CAN-message or by a calculation. The output's state upon module power-up is defined.

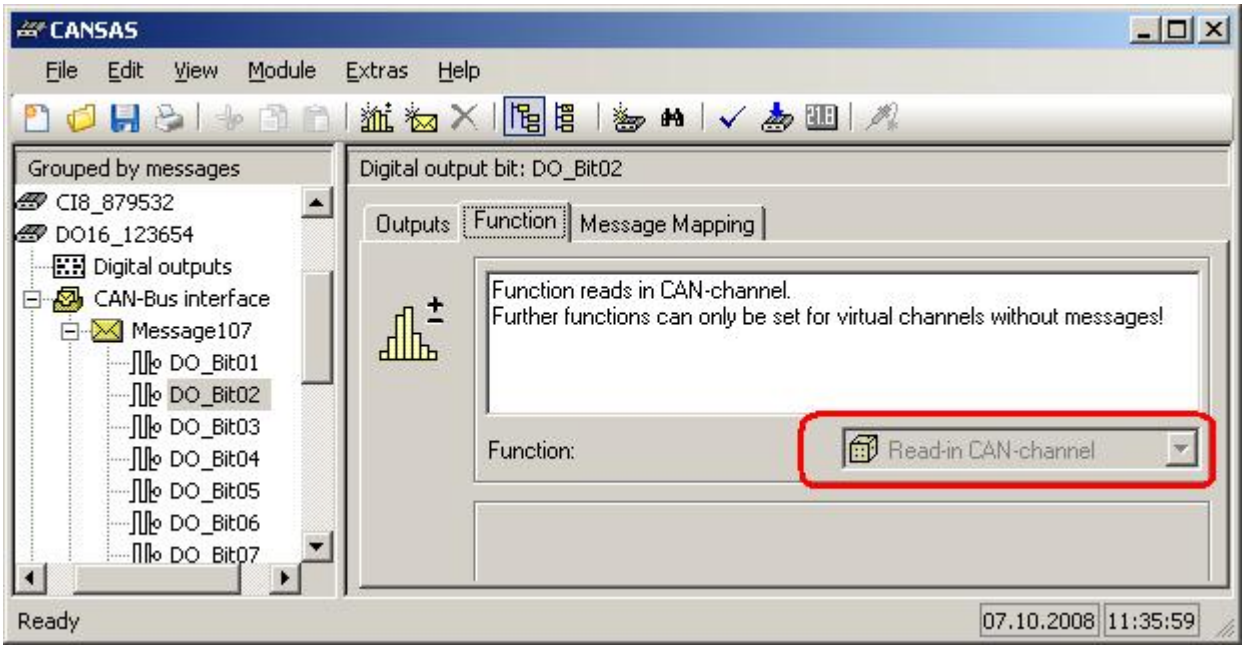
5.1.5.1 Outputs

All the outputs have switching times. For the module DO8R they can be up to 4 ms, for DO16 under 0,1 ms. In both cases the switching time is different for switching the output on or off.

In DO16R, each terminal's 8 outputs have a shared reference ground and are thus not isolated from each other. They are isolated from the 8 outputs of the other terminal, chassis, power supply and the CAN-bus.

5.1.5.2 Connecting an output signal with a CAN-message

If a certain output bit is to be set by a CAN-message, that output bit must be positioned in a message. The output bit's module tree entry can be positioned as desired by Drag & Drop in the module tree at any position in the message or under "No CAN-bus message". Note that the tree must be grouped by message for this to work (see View menu, item "Grouped by" 80). Then the output bit function **Read-in CAN-channel** is unalterably active.

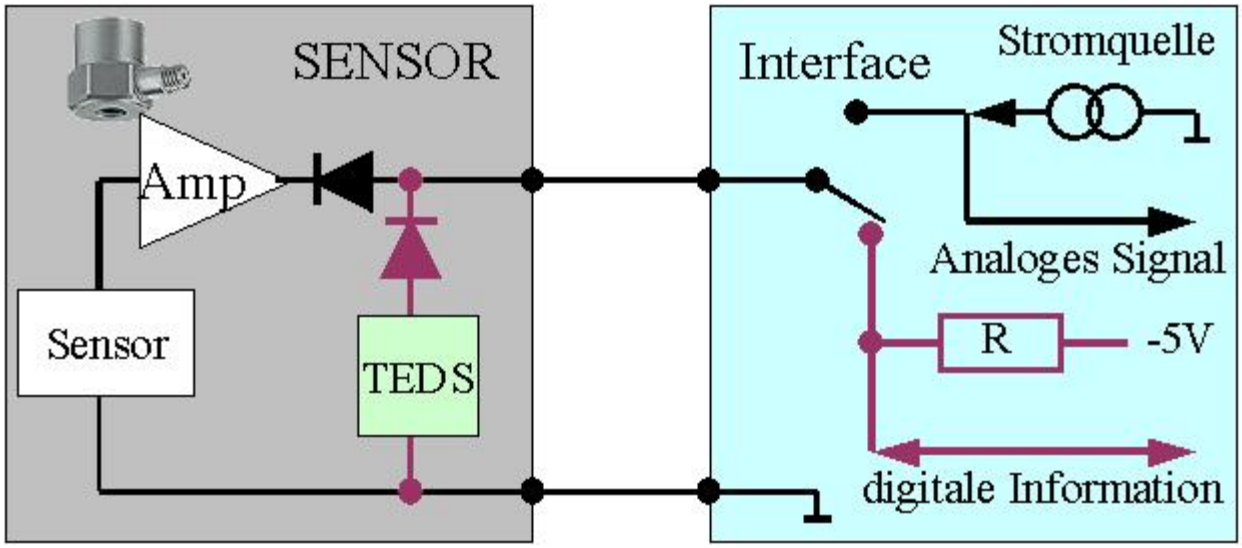


output bit DO_Bit02 is in CAN-message Message01. **The function is always set to"Read-in CAN-channel".**

On the index card ***Message mapping***, the data type, start byte and start bit can be specified. It makes sense to select digital bit as the data type for the digital output signal. The settings for the starting byte and starting bit specify which bit in the message determines the output signal value.Different bits can be joined

together into bit groups. The default entry *Automatic* means either no bit group membership or the first element of a group. If *extensions elements* are selected for subsequent bits, they belong to this group. In imcDevices, these grouped bits no longer appear as binary states but as unsigned integers.

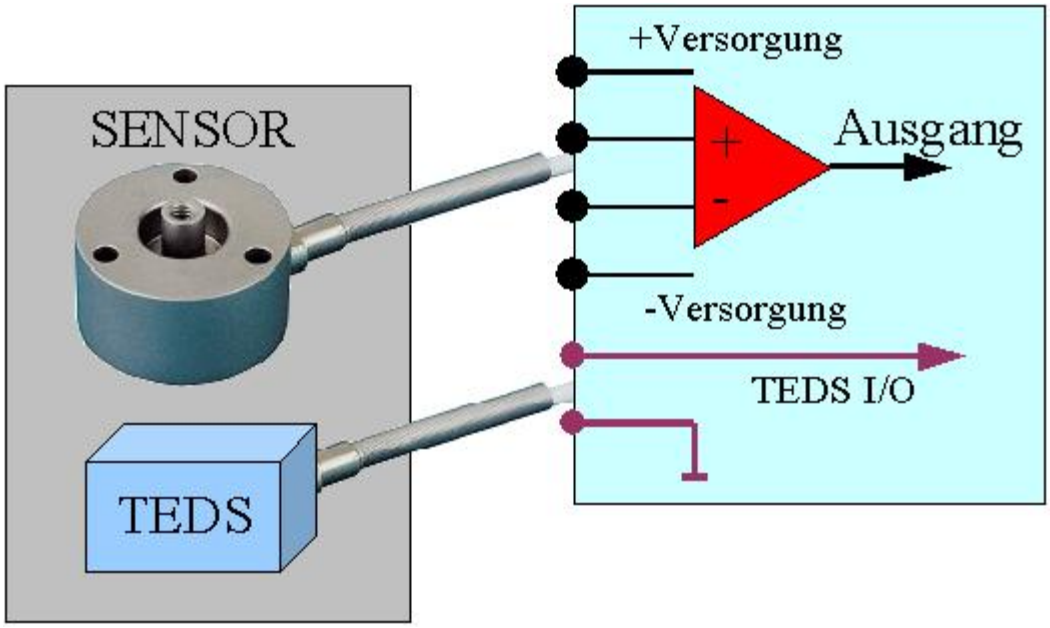
In the lower portion of the card, the output signal's state upon activation of the module can be specified.



Message mapping dialog for a digital output bit

5.1.5.3 Calculated output signals

If the output signal is not assigned to any CAN-message (the corresponding entry in the module tree is entitled "No CAN-bus message"), the signal value can be set according to a calculation. For this purpose, there are functions which can also be used for virtual channels (see chapter on virtual channels 67). If a digital bit is removed from a CAN-message, then the function "Fixed digital value" is assigned by default. A different function can be selected by the user.

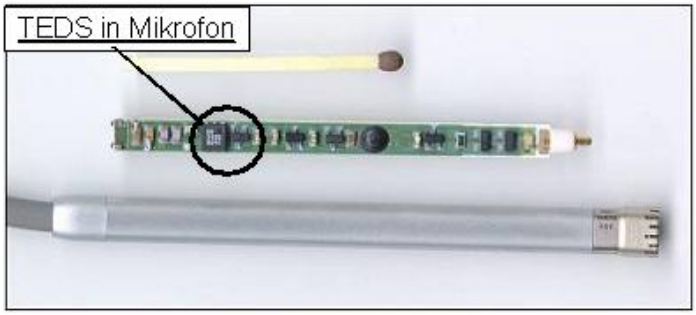


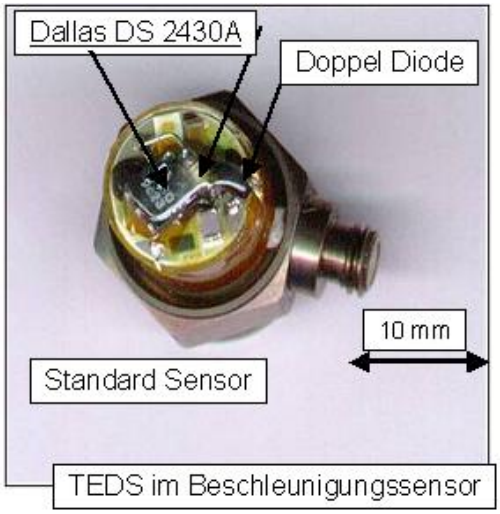
Dialog for setting the defining function of an output signal not assigned to a message

A digital output module can also read out an analog quantity (e.g. in the form of a 16-bit integer) from the CAN-bus. This quantity cannot be output in digital form, but it can be subjected to calculation. For instance, a value can be compared with a limit. The result of the comparison is a digital value (0 or 1), which can be output in digital form.

The illustration below shows as an example how the dialog for making CAN-bus settings. Note that a virtual channel was created and was placed in the message. This virtual channel is called "IsGreater". It doesn't

reflect the result of a calculation but simply assumes values read out of the CAN-bus. This value can be used by other calculational functions. Therefore, the virtual channel could just as well be named "Channel with data from the CAN-bus".

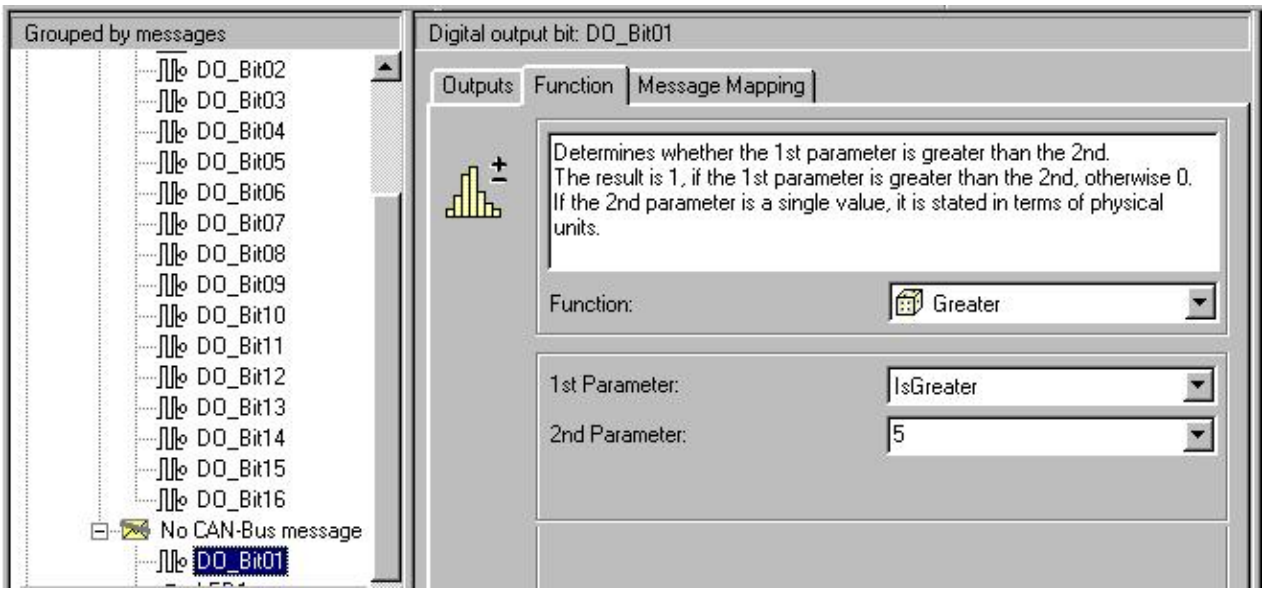




In this example, a 16-bit input quantity, scaled to take values from 0 V to 10 V, is read into the CAN-bus. The unit indicated is permanently set as "V", but the system doesn't take it into account. Therefore it wouldn't matter if an RPM-value were read in which is scaled from 0 to 6000RPM and not 6000 V.

The value which is valid when the unit is activated, the "Power-up value", is set to 0 V. This means that the virtual channel carries the value 0 V as long as no CAN-bus message arrives. While this is the case, the system calculates with the value 0 V and sets the digital value which corresponds to that voltage. When a message finally arrives, the value transmitted replaces the virtual channel's last valid value. The calculational functions then are applied to this new value and a digital value is set to correspond to the new calculation result. The virtual channel's new output value remains valid until a new value arrives from the CAN-bus.

The illustration below shows how the system performs a calculation with the channel. A digital output bit "DO_Bit01" appears under "No CAN-bus message" in the module tree. This indicates that this bit is not under the direct control of any CAN-bus message, but instead depends on a calculation. Therefore, a calculational function can be selected for this output bit. In this case, the function "Greater" is selected, and it evaluates the channel "IsGreater" as its input.



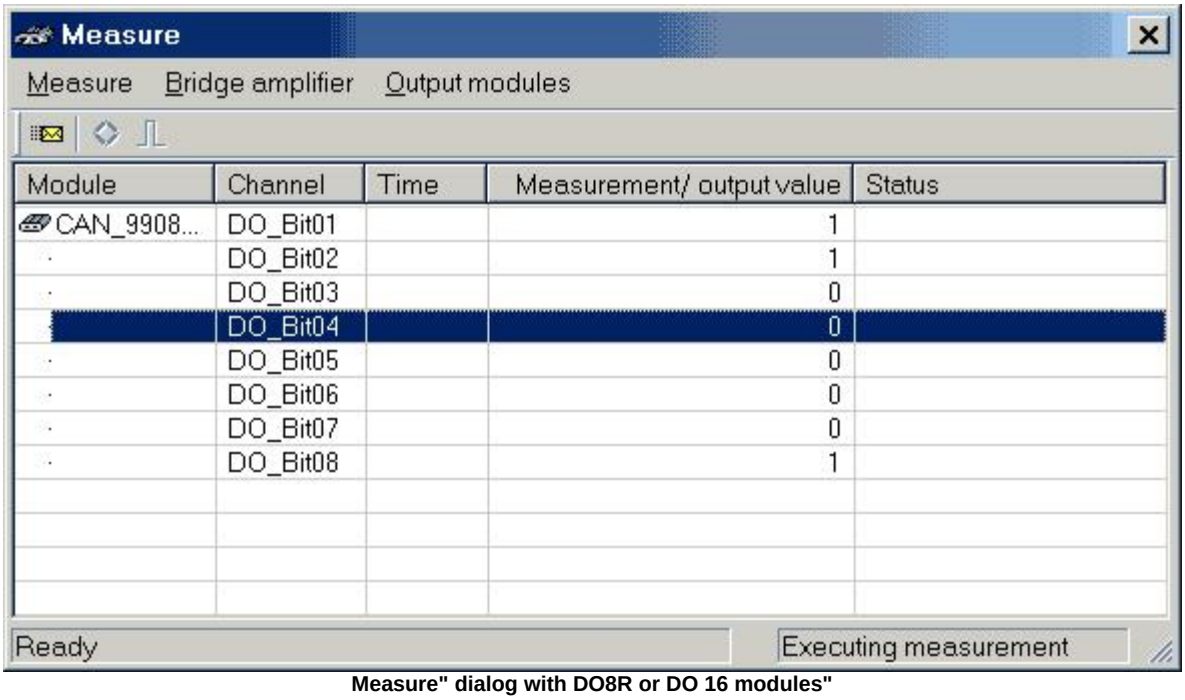
5.1.5.4 Notes on DO8R and DO16R

The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN-bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.

It is generally recommended to connect the housing (chassis) to ground (protective grounding line). The housing mainly consists of conduction material and is connected with DGND.

5.1.5.5 Taking measurements with the digital output modules

In the dialog **Measure**, the digital output bits of a DO16R or DO8R module are listed only if they are assigned to a CAN-message. In such cases, the entry for the **Measurement/ output value** represents the signal's output value. Upon the start of the measurement, the **Power-up value** is displayed. The output signal can be influenced by editing the values in the column **Measurement/ output value**. Double-clicking in these cells, the editing mode is activated, and the value for the digital bits can be toggled between 0 and 1. When the ENTER-key is then pressed, the value is checked, accepted and sent to the module.



Measure" dialog with DO8R or DO 16 modules"

For output modules, the items **Transfer all values** and **Transfer value after editing** under the **Output modules** menu are available.

Transfer value after editing

This function can be toggled on and off. If it is active, then any editing performed on the entry is immediately sent to the module. If the function is off, the new value becomes valid but is not transferred. This way, it is possible to set multiple bits and then transfer them as a unit by using the function **Transfer all values**.

Transfer all values

This function transfers the output values of all output modules shown in the window to the modules.

5.1.6 Temperature measurement

Two methods are available for measuring temperature.

Measurement using a ***Pt100*** requires a constant current, e.g. of 250 µA to flow through the sensor. The temperature-dependent resistance causes a voltage drop which is correlated to a temperature according to a characteristic curve.

In measurement using ***thermocouples***, the temperature is determined by means of the electrochemical series of different alloys. The sensor produces a temperature-dependent potential difference from the terminal in the CAN connector pod. To find the absolute temperature, the temperature of the terminal point must be known. For the Pt1000 this is measured directly in the terminal pod, and therefore an additional type of connector pod is needed.

The voltage coming from the sensor will be converted into the displayed temperature using the characteristic curves according temperature table IPTS-68. An exception are the modules µ-CANSAS-T1 and µ-CANSAS-T4, where voltage coming from the sensor is converted according to the IEC584-1 / ITS90 standard. The temperature ranges of these modules differ from the temperature ranges of normal CANSAS modules.

5.1.6.1 Thermocouples as per DIN and IEC

The following standards apply for the thermocouples, in terms of their thermoelectric voltage and tolerances:

Thermocouple	Symbol	max. temp.	Defined up to	(+)	(-)
DIN IEC 584-1					
Iron-constantan (Fe-CuNi)	***J***	750°C	1200°C	black	white
Copper-constantan (Cu-CuNi)	***T***	350°C	400°C	brown	white
Nickel-chromium-Nickel (NiCr-Ni)	***K***	1200°C	1370°C	green	white
Nickel-chromium-constantan (NiCr-CuNi)	***E***	900°C	1000°C	violet	white
Nicrosil-Nisil (NiCrSi-NiSi)	***N***	1200°C	1300°C	red	orange
Platinum-Rhodium-platinum (Pt10Rh-Pt)	***S***	1600°C	1540°C	orange	white
Platinum-Rhodium-platinum (Pt13Rh-Pt)	***R***	1600°C	1760°C	orange	white
Platinum-Rhodium-platinum (Pt30Rh-Pt6Rh)	***B***	1700°C	1820°C	n.a.	n.a.
DIN 43710					
Iron-constantan (Fe-CuNi)	***L***	600°C	900°C	red	blue
Copper-constantan (Cu-CuNi)	***U***	900°C	600°C	red	brown

If the thermo-wires have no identifying markings, the following ***distinguishing characteristics*** can help:

- Fe-CuNi: Plus-pole is magnetic
- Cu-CuNi: Plus-pole is copper-colored
- NiCr-Ni: Minus-pole is magnetic
- PtRh-Pt: Minus-pole is softer

The color-coding of compensating leads is stipulated by DIN 43713. For components conforming to IEC 584: **The plus-pole is the same color as the shell; the minus-pole is white.**

☞ **Note**

Only one thermocouple characteristic curve can be selected at the same time for one module. So it is only possible to measure thermocouples of similar type at the same time. Only at the CANSAS modules SC16, SCI8, SCI16 and CI8 it is possible to select different thermocouple characteristic curves at the same time.

The endings from the measurement ranges can drift about 1K from the device configuration.

5.1.6.2 Pt100 (RTD) - measurement

Aside from thermocouples, ***RTD (Pt100)*** units can be directly connected in ***4-wire-configuration*** (Kelvin connection). An additional reference current source feeds a chain of up to 4 sensors in series.

With the imc-Thermoplug, the connection terminals are already wired in such a way that this reference current loop is closed "automatically".

> If fewer than 4 Pt100 units are connected, the current-loop must be completed by a **wire jumper** from the "last" RTD to -*I4*.

If you dispense with the "support terminals" (±*I1* to ±*I4*) provided in the imc-Thermoplug for 4-wire connection, a standard terminal plug or any DSUB-15 plug can be used. The "current loop" must then be formed between +*I1* (DSUB Pin 9) and -*I4* (DSUB Pin 6).

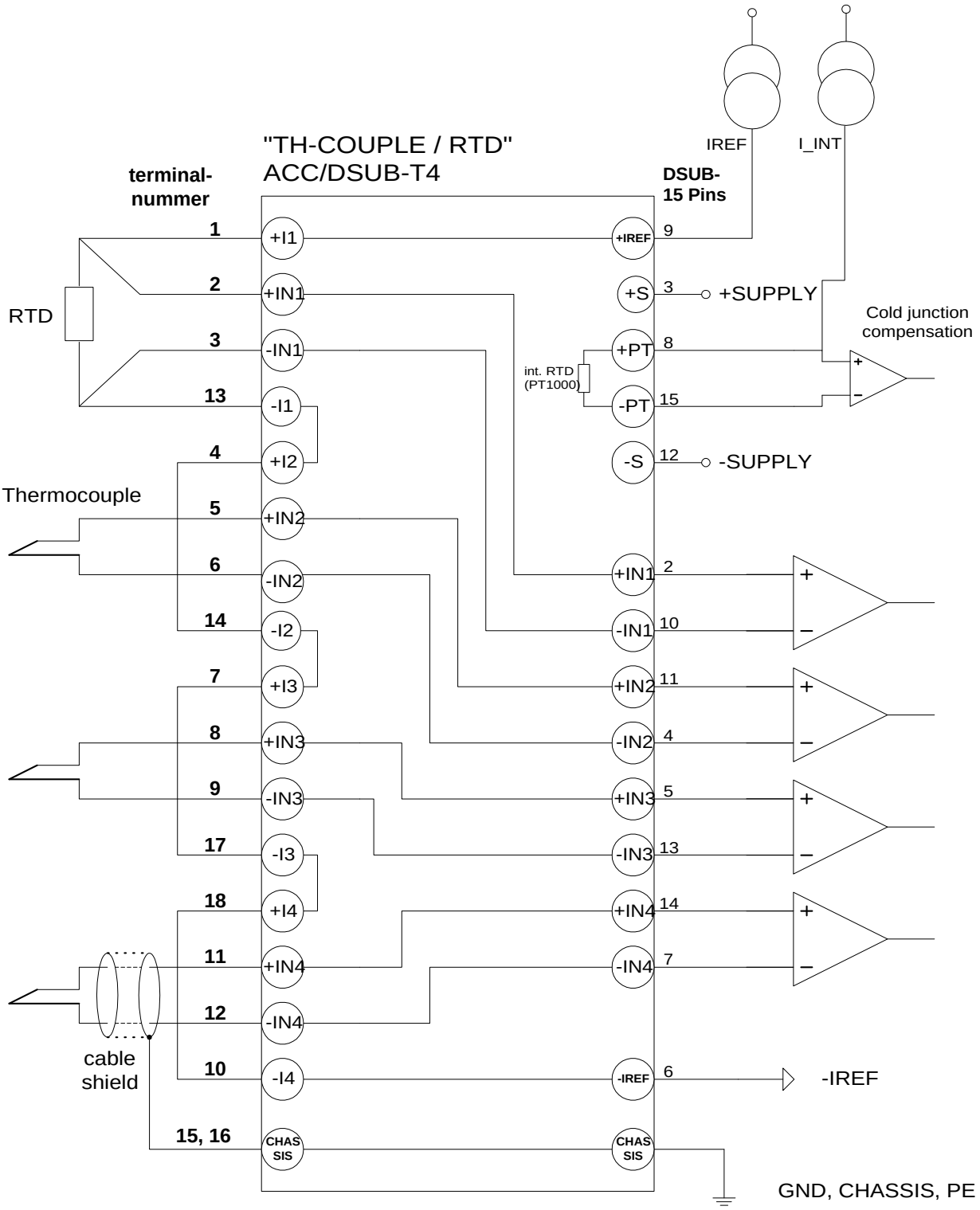
5.1.6.3 imc thermo plug

The imc-Thermoplug *ACC/DSUB-T4* contains a screw terminal block in a DSUB-15 plug housing with a built-in temperature sensor (Pt1000) for ***cold junction compensation***. This provides for direct connection of thermocouples of any type, directly to the differential inputs (+IN and -IN) without external compensation leads. That plug can also be used for **voltage** measurement.

The difficulty with thermocouple measurements are the "parasitic" thermocouples which inevitably form where parts of the contacts made of different materials meet. The temperature sensor measures the temperature at the connection terminal and compensates the corresponding "error"-voltage. Normally, the connection to this compensation point (inside the device) is made by special compensation leads or plugs made of material identical to the respective thermocouple type, in order not to create additional (uncontrolled) parasitic thermocouples.

imc's system avoids the problem through the use of individual compensation sensors directly inside the connector plug, thus offering an especially simple, flexible and cost-effective connection solution.

5.1.6.3.1 Schematic: imc-Thermoplug (ACC/DSUB-T4) with isolated voltage channels



5.2 Sampling rates: Scanner concept

The following is a discussion of data acquisition with multiplexers and the limitations associated with it. This will include a contrast of conventional scanners (e.g. C12) to systems working in the so-called Burst mode (e.g. SCI8, SC16).

Conventional scanner systems work at a fixed sampling rate, namely the highest rate at which switching between channels takes place *(fast scanning)*. If the sampling rate actually set is less than the maximum possible data rate, then an average of multiple samples taken at the high sampling rate is computed (filtering).

The maximum sampling rate is substantially determined by the scanner's transients, i.e., the switching times and the transients of pre-amps, of analog (and any digital) filters, and of ADCs.

Since the system's bandwidth must be quite high for the transients to subside within the interval corresponding to the *"aggregate sampling rate"*, while on the other hand the *channel-sampling rate* is lower by at least the factor n=channel count, the conditions for the Sampling Theorem will necessarily be violated. Aliasing effects which cannot be filtered out will result.

This dilemma, characteristic of scanner systems, can be significantly mitigated at least in the case of a flexibly configured, low-speed measurement (e.g. of temperature). For that purpose, the rigid sampling scheme is adapted in accordance with **block-measurement** and –averaging ("**Burst-mode**"). Thus, flexible adaptation of the scanner timing enables disturbance- and aliasing-free low-speed precision measurement.

The Burst mode is based on making optimal use of the time spent while the signal experiences its transients. Not only a single measurement of the selected channel is performed, but a block measurement over a period of time at least equally long or a multiple of the time period. By this means, the total cycle time is mostly used for data acquisition and no longer mainly by the cumulative transient time.

The block measurement is performed by a high-speed analog/digital converter (ADC) having a data rate which is a multiple of the max. aggregate sampling rate. An anti-aliasing filter adapted to this data rate ensures aliasing-free acquisition within the block. This block is then digitally filtered and becomes a data stream whose bandwidth is flawlessly limited and perfect for frequencies above the block filter's. This data stream is in turn "re-sampled" at the actually intended channel sampling rate. While it is true that this channel rate is lower than the block-averaging filter's bandwidth, and that anti-aliasing effects could theoretically occur for that reason, the conditions are vastly less extreme than with *“fast-scanning“*: the range of possible aliasing errors is now limited to between one-half of the channel sampling rate and the block filter's cutoff frequency. This range has a frequency ratio of approx. 14 to 28 (depending on the module type), and, with the sampling rate suitably selected, it lies below the critical frequency ranges from 5 0 Hz on, in which the relevant interference is expected.

This procedure thus has the following ***advantages***:

- flexible configuration of low-speed precision measurements and high-speed measurements with one and the same affordable scanner system
- Optimal aliasing-free noise suppression of even 50 Hz interference in spite of a scanner amplifier's relatively high bandwidth

Note the following constraints: The block averaging time is not channel-specific. It is based on the smallest sampling rate set in the system. All ***channels used***, including ones not outputted directly but rather used to calculate ***virtual channels***, are instrumental! The procedure thus provides only advantages if all channels are set to one low-speed sampling rate which determines the noise suppression properties.

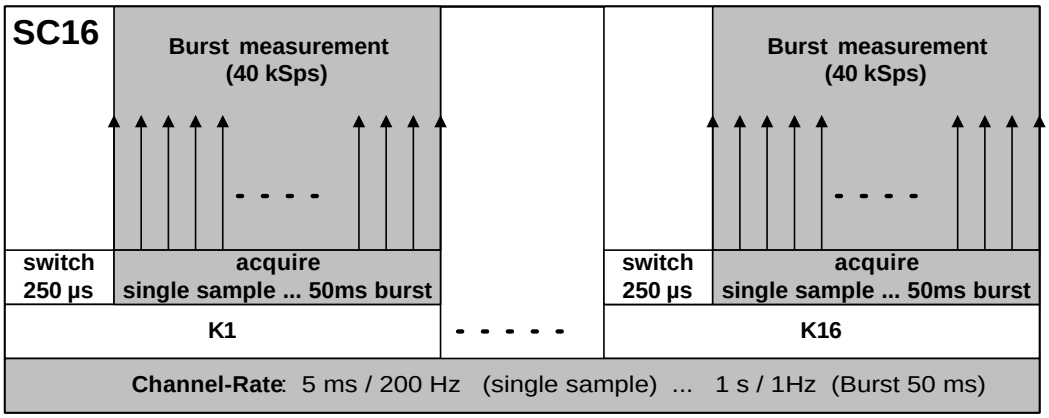
Note also that systems using a multiplexer also have a time offset between channels. This is automatically corrected computationally, in fact by means of a filter having a transit time (delay) which depends on the sampling rate. This additional delay is based on the highest-speed sampling rate set for the module.

This (non-recursive) time-offset compensation filter additionally leads to a characteristic overtravel upon jumps in the signal. However, this property is independent of the Burt-mode's characteristics.

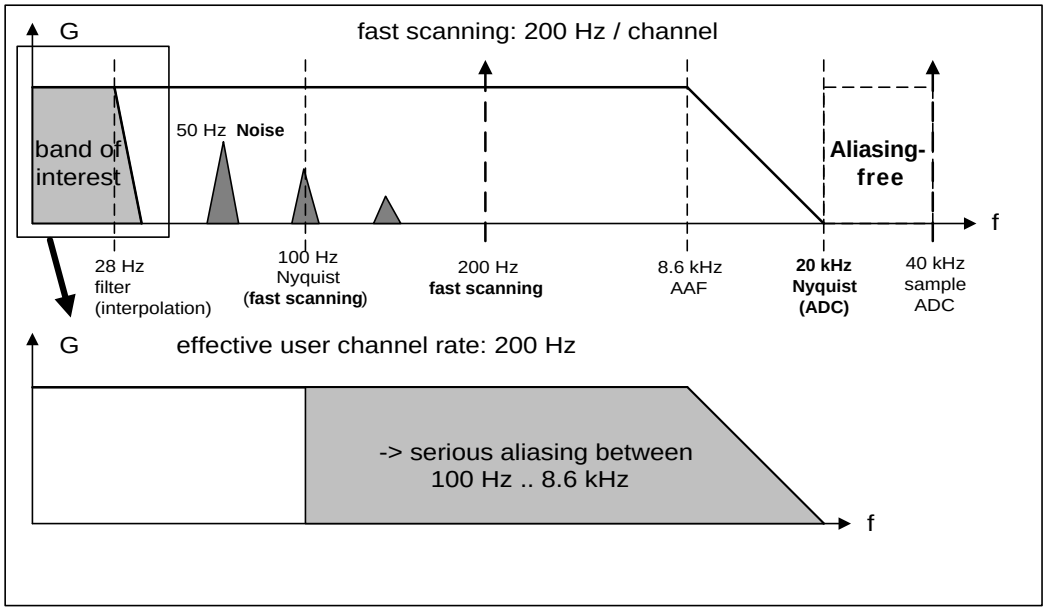
A summary of applicable ***constraints***:

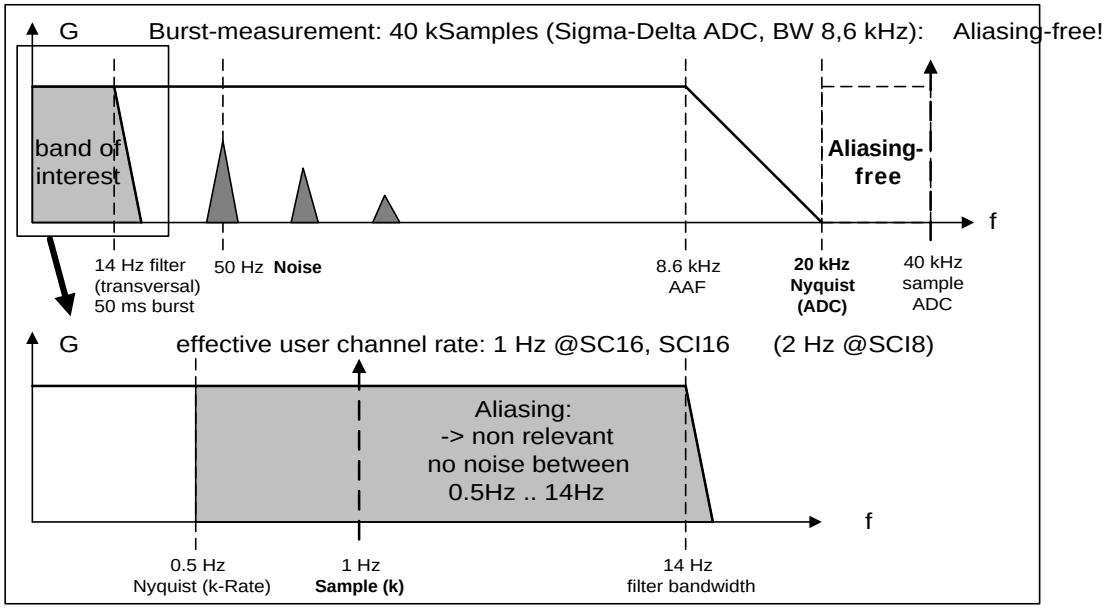
- The highest-speed sampling rate (of all used, including channels used to derive virtual channels) determines the averaging interval and thus the noise suppression properties of all channels.
- Additional signal transit time due to automatic time offset correction is determined by the highest sampling rate.

Scanner timing:


SC16
Burst measurement (40 kSps)
Burst measurement (40 kSps)
switch 250 µs
acquire single sample ... 50ms burst
switch 250 µs
acquire single sample ... 50ms burst
K1
K16
Channel-Rate: 5 ms / 200 Hz (single sample) ... 1 s / 1Hz (Burst 50 ms)

Filter concept: fast scanning vs. burst mode:




G
Burst-measurement: 40 kSamples (Sigma-Delta ADC, BW 8,6 kHz): Aliasing-free!
band of interest
Aliasing-free
f
14 Hz filter (transversal) 50 ms burst
50 Hz Noise
8.6 kHz AAF
20 kHz Nyquist (ADC)
40 kHz sample ADC
G
effective user channel rate: 1 Hz @SC16, SCI16 (2 Hz @SCI8)
Aliasing: -> non relevant no noise between 0.5Hz .. 14Hz
f
0.5 Hz Nyquist (k-Rate)
1 Hz Sample (k)
14 Hz filter bandwidth

5.3 CAN-Bus: Delay times

Here we will deal with the question of how much delay there is between a measured value's acquisition and when it is outputted on the CAN-Bus. This is an important issue if the module is used for process control purposes, in which the system is to respond to the currently valid measurement value. For measurement tasks only involving data recording, the delay time is negligible.

The delay time is the time difference between a signal's sampling time and the instant and when the corresponding message is outputted on the CAN-bus.

The following time intervals each make a contribution:

- The signal's propagation time through the input amplifier and the analog anti-aliasing filter.
- Delay time of the analog/digital converter
- Duration of the digital processing, e.g. correction and digital filtering
- Construction of the CAN-message. This involved waiting for acquisition of all measurement values to be included in the CAN-message.
- Waiting period until the CAN-controller has sent its last message and this message has been entered into the CAN-controller's register.
- The CAN-controller next tries to take the next best opportunity to put its message onto the CAN-Bus. This involves waiting for transmission disturbances and higher-priority messages to pass.
- The actual transfer of the CAN-message. For a full message and at 500kbit/sec, this can be up to 0,2 ms.
- Additional time intervals may accrue in receiving the message.

In this context, it's only possible to state the delay time till the point when the CAN-controller is prepared to transmit the message. We assume that the CAN-Bus is undisturbed and there are no other modules currently outputting messages on the bus; only then can a module's delay time be stated. The user can then compute for his own CAN-configuration what delays will result from higher-priority messages.

The delay time is stated for the module's default setting. This means for four adjacent channels in a CAN-message, starting with Channel 1. One flashing LED and no additional virtual channels.

Other factors influencing the delay time:

- Other message structures. E.g. Channel 1 and Channel 16 in one message for a module (like the SCxx modules) using a multiplexer. Since Channel 1 is sampled at the beginning and Channel 16 really at almost the end of a sampling interval, the message can only be outputted at the end of the sampling interval, thus delaying Channel 1 significantly, and Channel 16 almost not at all. For quick response, only adjacent channels (e.g. 1 through 4) should be placed in a message.
- Virtual channels are always calculated after a delay. For swift response, no virtual channels should be packaged in a message.
- Synchronicity: In synchronized mode, old messages are outputted on the CAN-Bus following disturbances on the bus so that they can be collected in chronologically correct order without data loss by the data acquisition device. For swift response, the synchronized mode should not be used if bus disturbances are to be expected.
- Choice of CAN identifier: Messages for which the user wishes to have rapid responses should have lower CAN-identifiers (and thus higher priority) than other existing CAN-messages.
- Choice of sampling interval. Observe the tables in chapter 6 and their explanations.

- The specifications in the tables in chapter 6 are valid for:
  - For SCxx modules: Use the same sampling time for all channels.
  - Only position channels with the same sampling rate in a single message. Only then are the specifications in the table valid.
- With some module types, (such as SCxx modules), the filters can be deactivated. If the filters are deactivated, the delay times are correspondingly shorter. This is because the low-pass filters used cause delay. Only use of the filters ensures the validity of the spec sheet data concerning signal noise, suppression of common mode frequencies and synchronization of sampled values. If the filters are deactivated, the delay time is reduced, but in that case it's the user's responsibility to measure signals which are good enough not to need filtering and also that the synchronization of multiple channels doesn't play any role.

5.4 Isolation, Grounding and Shielding

5.4.1 Isolation

CANSAS-modules consist of 3 components which are all mutually isolated as well as from the enclosure (CHASSIS):

- Analog-inputs
- Power supply unit
- CAN-bus

5.4.2 Grounding

It is assumed that the module enclosure (CHASSIS) is electrically grounded as part of its installation.

The dark (gray), oxidized aluminum enclosure is, by virtue of the oxidization, non-conducting or very weakly conducting. Therefore, when grounding, use the attachment nuts on the enclosure faces (beside the ***DSUB*** -sockets).

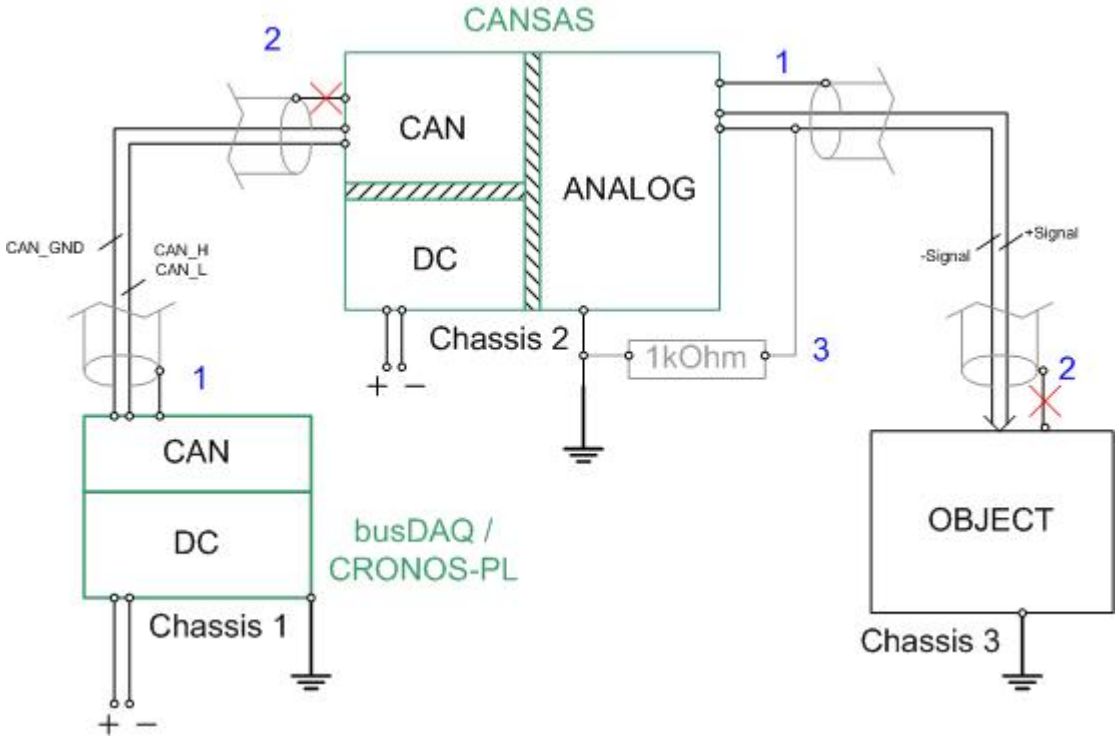
When the module enclosure is grounded, the guidelines for *"Base-isolation"* (as per DIN 61010-1, Contamination Level 1) are valid for the isolation voltages vis-à-vis the enclosure.

For the mutual isolation of the input channels, the valid guidelines are those for *"double isolation"* (as per DIN 61010-1, Contamination Level 1), see technical specification 266 of the modes.

CANSAS-SL, µ-CANSAS and µ-CANSAS-HUB4

With these module types, it is possible to use the cable shielding of the CAN terminals, or the Chassis contact taking the form of a fastening bolt (only with CANSAS-SL, µ-CANSAS-HUB4 and the 4-channel µ-CANSAS), to establish the housing voltage level.

Example for grounding



Note the following points:

1) The shielding for the CAN-bus connection is grounded on one side.

2) The shielding may not be connected on both sides since ground loops could result otherwise.

3) In order to avoid common mode errors, the signal reference can be connected to CANSAS ground via a resistor.

5.4.3 Isolation voltage

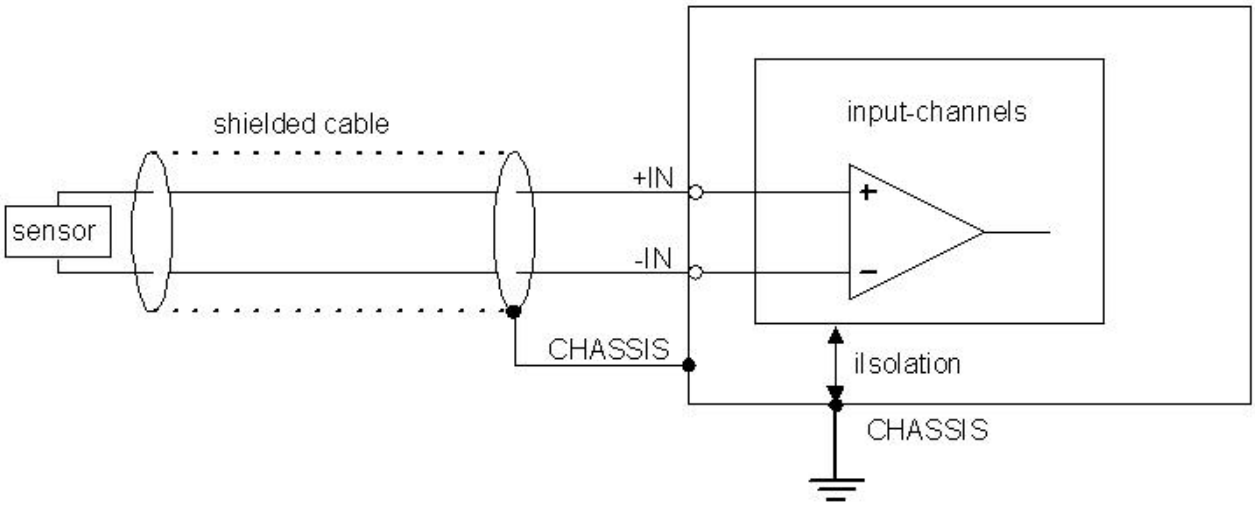
See the spec sheets 380 for the respective module.

5.4.4 Shielding

As a matter of principle, the use of shielded and grounded cables is necessary for conforming to the EMC and noise suppression parameters.

In many cases the use of a cost-effective, multi-wire, single shielded cable is adequate (even for many cables).

Single shielding

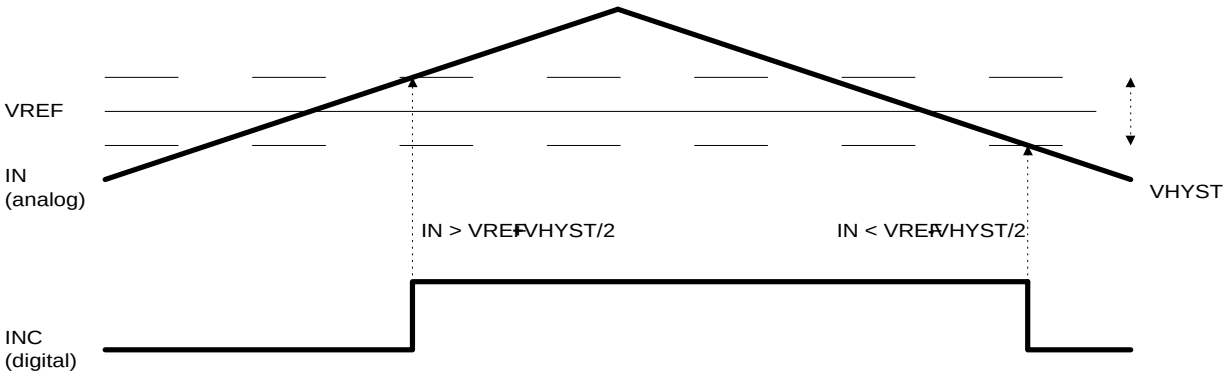


But some cases can require double-shielded cables, meaning a common, grounded (CHASSIS) ***sheath***, in which (perhaps multiple) individual ***coaxial lines*** are contained.

The following situation in particular can require double shielding in order to protect against noise.

- "high" internal resistance of the signal source (> 100Ω)
- ungrounded signal sources (isolated or having high impedance to the CHASSIS and/or power supply reference ground)

Double shielding:



To avoid compensation currents, always connect the shielding to one side (potential) only.

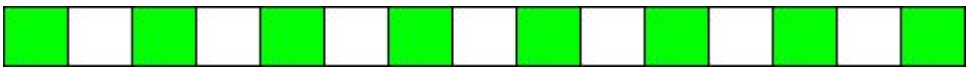
5.5 CANSAS blinking codes

The CANSAS modules come with an LED which can shine in three colors.

The available colors are the primary colors Red and Green plus their resulting composite color yellow. With few exceptions, the light-blinking codes apply for almost all the modules. The UNI8 module has two additional LEDs which can be freely configured and only shine yellow light.

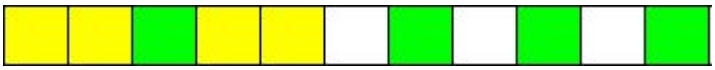
5.5.1 Normal operation

In normal operation, the LED blinks green at constant intervals. Once the power supply is connected to the device, various blinking codes are emitted, which depend on the module and on its firmware version, before the blinking pattern reverts to constant green blinking.



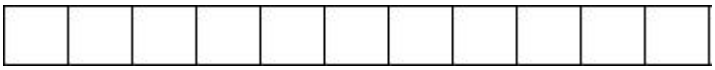
5.5.1.1 Successful configuration

Once a module has been configured successfully, a blinking code is emitted. The LED flashes yellow once for a long duration, then once briefly green, then once more yellow and long and then goes off. A short time later, the device begins blinking again in indication of normal operation.



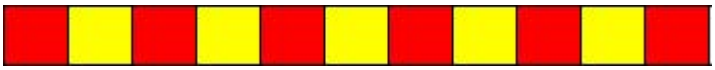
5.5.1.2 With device's Reset-plug

While the Reset-plug is attached at the device, the LED dies **not** flash. The LED also doesn't flash after withdrawal of the Reset-plug until either a configuration for the module has been successfully completed, or the module has been disconnected from the power supply and then reconnected to it.

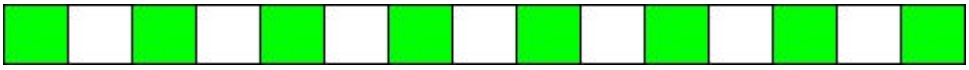


5.5.1.3 Synchronization

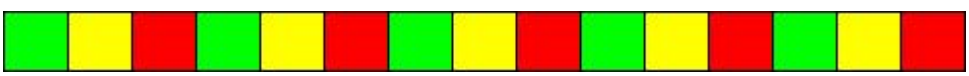
If a module is configured as the Master for synchronization purposes, then following successful configuration is alternates blinking in yellow and red (blink code: wait for other module) until it is connected with another module via the CAN-Bus. For this, it doesn't matter whether or not the other module is set to the corresponding Slave-mode.



Once the connection has been securely set up, the module blinks normally again in green.

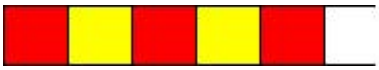


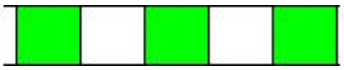
If there is no connection to any other module within 5 – 10 seconds, then a blinking code consisting of a mix between the code for normal operation and the code for ***"Wait for other module"***, namely alternating green, yellow and red, is emitted. The device is then in an undefined state.



If a module is configured as the **Slave** for synchronization purposes, then following successful configuration is alternates blinking in yellow and red (blink code: wait for other module) until it is connected with another module via the CAN-Bus. Toward this end, the other module **must** be set to the corresponding Master-mode, in order to be able to provide the necessary synchronization signal. Once connection to an appropriately configured module has been achieved, the module resumes the normal green blinking pattern.

If a module configured as a slave is to be disconnected from the synchronization signal after having been successfully synchronized, it reverts to the blink code “Wait for other module” (yellow-red). Then it’s sufficient to connect the module with another module to make it blink in green once again. In this case, it continues blinking green even though it isn’t receiving a synchronization signal.





Note

- µ-CANSAS' LEDs must be configured in order to be able to indicate synchronization. See the section CANSAS blinking codes 188.

5.5.1.4 Fault condition in device

If, however, a fault condition occurs in the device, then a special blinking code is emitted by the LED. This particular blinking code can indicate which error is involved.

A CANSAS device error’s blinking code consists of a sequence of 7 blinks in various colors which depend on the particular error which occurred. This blinking code is emitted for the whole time, as long as the device is on.

The error code is commenced with the first three blinking signals in which the LED shines red three times. The LED’s following four blinking signals make up the actual error code and provide information on the error’s location and type. In this context, the first two flashes constitute the top-level code (location), while the last two flashes are the subordinate code (type). The error code’s 7-flash signal is then repeated.

3 * RED	Same for every error message. Indication that an error occurred.	
2 * X	Flashes for the top-level error code.	
2 * Y	Flashes for the subordinate error code.	
	X and Y can take the following combinations of color values:	

Top-level code	Description	Subordinate code	Error description
RED --- YELLOW	CRC-error	RED --- RED	BOOTER
		RED --- YELLOW	FIRMWARE
		RED --- GREEN	PARAMETER BLOCK
		YELLOW --- YELLOW	CONFIGURATION
RED --- GREEN	Fault in analog	RED --- RED	PLUG ERROR
		RED --- YELLOW	MODULE TYPE
		RED --- GREEN	DIV THERMO
YELLOW --- GREEN	Access error in Flash	RED --- RED	NO ACCESS
		RED --- YELLOW	ERROR WRITING
		RED --- GREEN	DELETE ERROR BLOCK
		YELLOW --- RED	DELETE ERROR CHIP
		YELLOW --- YELLOW	FLASH PAGE TOO SMALL
GREEN --- RED	CanBus-access	RED --- RED	LINE TROUBLE

Top-level code	Description	Subordinate code	Error description
		RED --- YELLOW	PACKET LOST
GREEN --- YELLOW	Fifo	RED --- RED	FIFO FULL
		RED --- YELLOW	FIFO EMPTY
GREEN --- GREEN	General internal error	RED --- RED	ILLEGAL CALL
		RED --- YELLOW	ILLEGAL DATA
		RED --- GREEN	ILLEGAL LENGTH (structure)
		YELLOW --- RED	RAM TEST
		YELLOW --- YELLOW	NO ONLINE
		YELLOW --- GREEN	INITIALIZATION FPGA

For the CANSAS modules UNI8 and Canser, there are additional blinking codes which, however, do not indicate device errors but rather a status or an external error.

5.5.1.5 UNI8 - TEDS

With the UNI8 module, particular blinking codes for status indication are already set as default settings. These can be arbitrarily changed and adapted to the user's own requirements. The default settings for the blinking codes for the respective modules are:

Module-status	Color	Blinking code
Other or no sensors[1]	RED	LED blinks rapidly
For "Not adjusted"	GREEN	LED blinks rapidly
For "Stored adjustment values"	GREEN	LED blinks normally
For "Successfully adjusted"	GREEN	LED blinks normally
For "Adjustment running..."	YELLOW	LED shines (no blinking)
For "Shunt calibration running..."	YELLOW	LED shines (no blinking)

[1]TEDS-sensors: blinks only red after a TEDS-sensor was connected any time before

5.5.1.6 Canser GPS

For the Canser GPS, there are only two blinking codes which indicate an external error.

Blinking code	Significance
GREEN blinking	Module functioning
YELLOW blinking	No GPS-mouse connected; contact to mouse lost
RED blinking	CAN-transfer disturbed: - CAN-Bus not connected or no further participants on bus - No GPS-data since CAN-transmission was disturbed

5.5.1.7 µ-CANSAS and µ-CANSAS-HUB4

µ-CANSAS-HUB4:
There are two status-LEDs for the µ-CANSAS-HUB4, a green one to the right of CAN OUT and a red one next to CAN IN.
It is possible to set which of the two LEDs indicates normal operation, and by which flashing pattern. When the module is started, the red LED flashes briefly. Next it darkens again, or flashes according to the specified pattern in case the red LED was set to indicate normal operation mode.

The µ-CANSAS-HUB4's four inputs (IN1...IN4) each have their own status-LED. If no module is connected at the input, the corresponding LED remains off. If a module was detected at the input and if that module was last configured at the same input, then its associated LED shines solid green. If a module was detected at the input whose configuration does not match that of the module most recently configured at the same input, then its associated LED shines solid red. If a module was unplugged from the input, the associated LED goes dark.

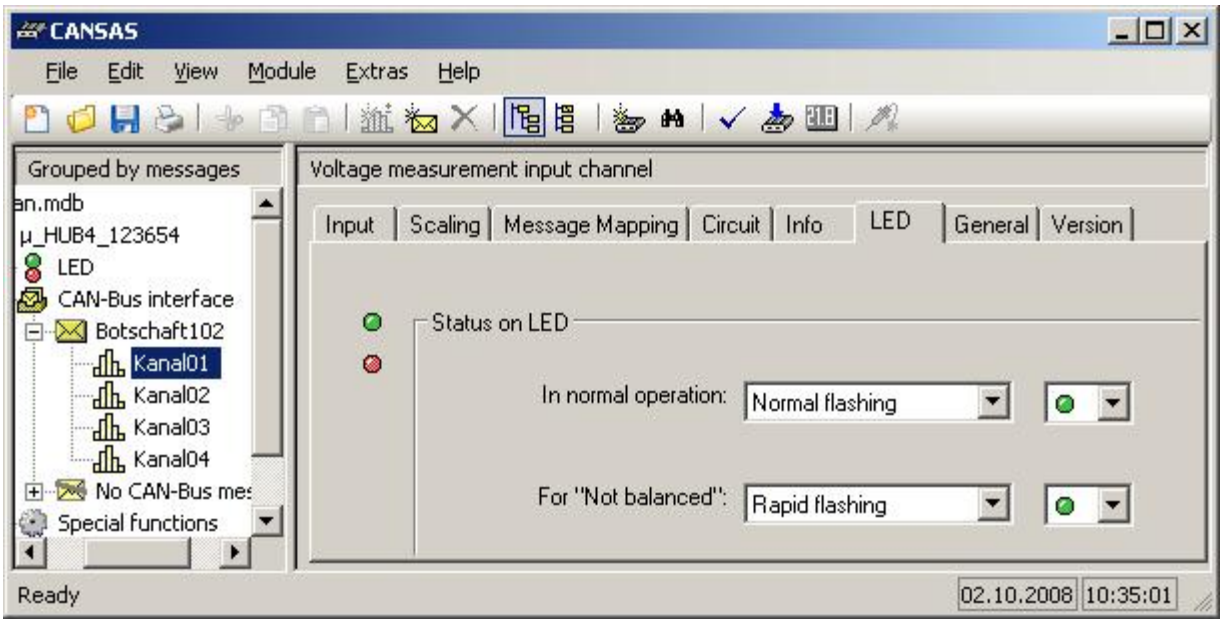
Additionally, the note pertaining to 4-channel µ-CANSAS modules also applies here.

1-channel µ-CANSAS module at the µ-CANSAS-HUB4 or in synchronized operation:
The red LED shines until synchronization with the µ-CANSAS-HUB4 or another CAN1 Master module is complete and the module begins transmitting measured values. The green LED behaves according to the configuration given to it by the user both during and after the synchronization phase.

4-channel µ-CANSAS module:
For each input (IN1...IN4) and for the overall module there is one 2-color LED. After startup, the module LED (LED next to CAN IN) briefly flashes red. The inputs' LEDs behave like the LEDs description in Synchronization 188 for as Slave working modules.

☞ **Note**

A 4-channel µ-CANSAS module responds like four 1-channel µ-CANSAS modules all connected to one HUB4. For each channel, a page for the LED is displayed. This must also be set if you wish to see that the channel has been recorded and balanced in synchronicity.



µ-CANSAS module not run from the µ-CANSAS-HUB4, or not in synchronization mode:
The red LED briefly shines after startup. Next, the LEDs light up according to the user's configuration. Either green or red must be chosen for the configuration, not both together (as previously described in reference to the µ-CANSAS-HUB4). Also note the previous note pertaining to the 4-channel µ-CANSAS module.

☞ **Note**

- During configuration or firmware updates, the LEDs may flicker. Upon successful completion of the configuration or update, the LEDs resume to behave as previously described. With modules which allow zero balancing (taring), the red LED flashes during the balancing procedure at a high flashing frequency.

5.6 Features and modules

Many features available with the CANSAS software version 1.4 are dependent on the hardware properties of particular CANSAS modules. This means a particular hardware version, i.e. a specific circuit board, is required in order to access the software features. The list below indicates which features are associated with which production dates. If you detect any discrepancies, please contact our hotline for an exact clarification of your hardware version.

Below is a table of general features available as of the production date stated. Explanations of the features appear further below.

Module	Slot	Synchronization	Readable configuration	imc-Sensors
C12	--	--	--	--
ISO8	--	--	--	--
BRIDGE2	--	--	--	--
DI16	from 06-2009	--	from 2006	--
L-DI16	from 07-2003	--	all	--
IGN	--	--	all	--
INC4	from 09-2003	from 2006	from 2006	--
L-INC4	from 07-2003	from 09-2003	all	--
DO16	from 12-2003	--	from 12-2003	--
DO8R	from 12-2003	--	from 12-2003	--
DO16R	from 07-2003	--	all	
DAC8	from 09-2003	--	from 2006	--
L-DAC8	from 07-2003	--	all	--
PWM8	all	--	all	--
C8	all	all	all	--
UNI8	from 07-2003	from 06-2003	all	all
P8	from 07-2003	from 08-2003	all	--
SCI8	all	all	all	from 02-2007
SCI16	all	all	all	from 02-2007
SC16	all	all	all	from 02-2007
CI8	all	all	all	all

DAC8: special feature from production date

Module	Outputs each set for I/U separately
DAC8	from 09-2003

UNI8: special feature from production date

Module	Sensor recognition	Bridge measurement	PT100 inside the connector	Sensor recognition by jumper configuration
UNI8	from 01-2003	from 03-2003	from 08-2003	from 07-2003

PWM8: special feature from production date

Module	TTL	current > 1A
PWM8	all	all

Description of features

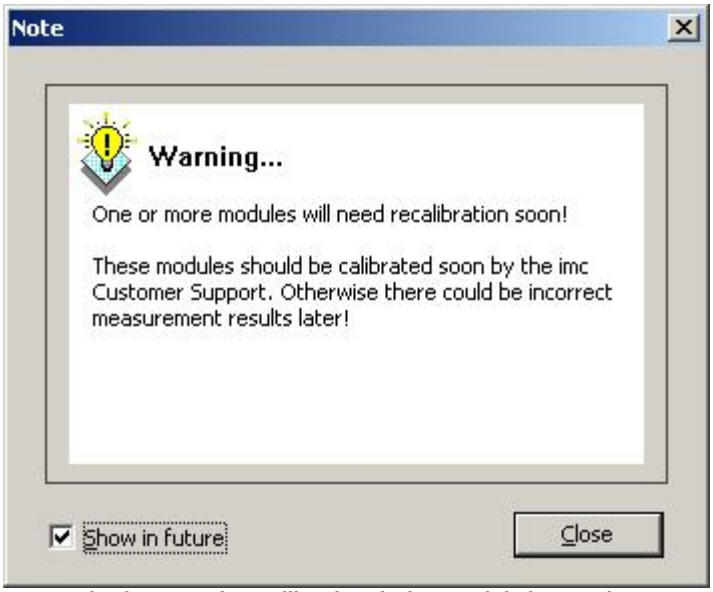
Feature	Definition
Slot	The Eprom (TEDS) with slot recognition is readable (and writable).
Synchronization	The data acquisition modules work in synchronization, i.e. the sampling is simultaneous. See the section Synchronization 112.
Readable configuration	A module's configuration can be saved to the module in a way which can be read back. This means that the configuration can be imported from the module when it is integrated into the system. See Extras - Options 94.
DAC8: outputs each set for I/U separately	The DAC8's output channels can each be switched separately between voltage and current. If the feature is not available, then it is only possible to switch between voltage and current for the entire module.
Sensor recognition	The Eprom of the sensor connected is readable. The data it contains can be used to make settings for the channels.
UNI8: Bridge measurement	Only for UNI8: measurement bridges can be connected.
imc-Sensors	The module is connected with the sensor database imc-Sensors. The data it contains can be used to make settings for the channels.
UNI8: sensor recognition by jumper configuration	A shorting jumper inside the connector is used to detect a Type K thermocouple.
UNI8: Pt100 inside the connector	Only for UNI8: With thermocouple measurement, the temperature of the cold junction point can also be measured inside the connector by placing a Pt100 inside the connector.
UNI8: current with built-in 120 Ω resistor	Single-end current measurement with a 120Ω resistor built into the module
UNI8: 350Ω ¼-bridge	Connection and measurement of a 350Ω ¼-bridge is possible.
UNI8: 120Ω ¼-bridge	Connection and measurement of a 120Ω ¼-bridge is possible.

5.7 Calibrating the modules

There are two stages of calibration reminders. First there is a preliminary warning which begins as of x months before the recommended calibration validity expiration. After elapse of the recommended validity term, a due date notification indicating the last calibration date is posted.

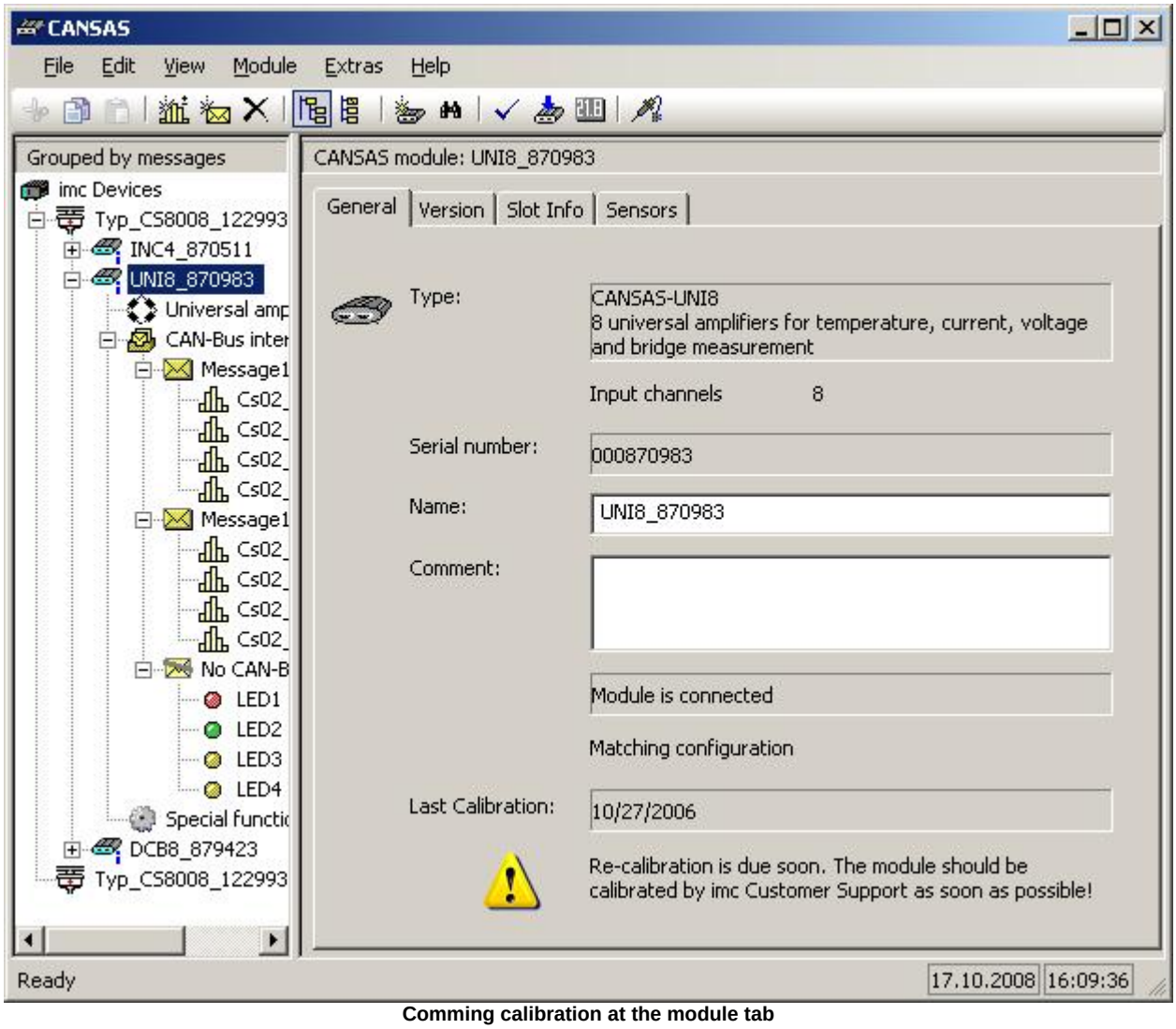
5.7.1 Prompt for next calibration

When a new module is integrated into the system, the following message appears if the recommended calibration date is has been reached:


Note
Warning...
One or more modules will need recalibration soon!
These modules should be calibrated soon by the imc Customer Support. Otherwise there could be incorrect measurement results later!
Show in future
Close

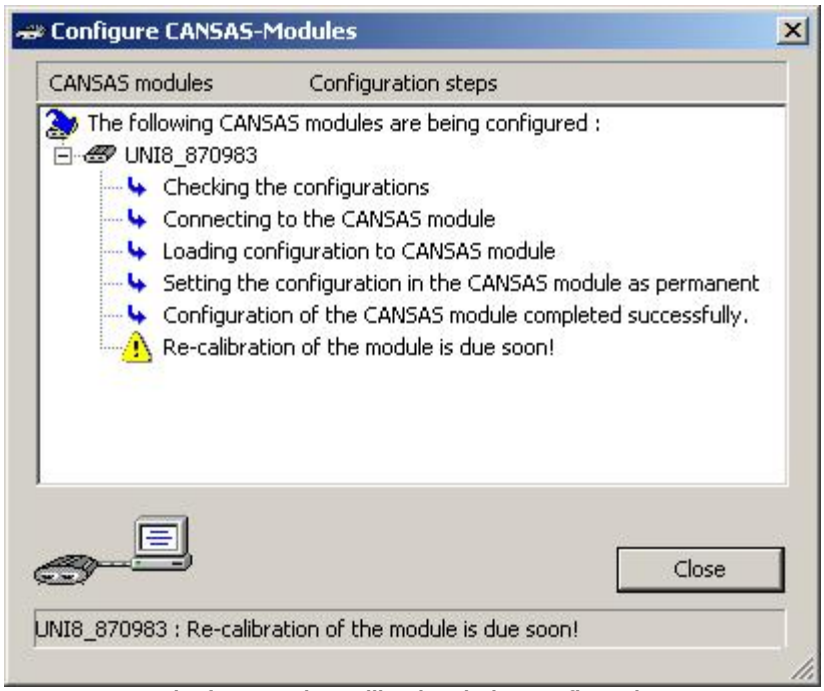
Hint for comming calibration during module integration

On the module's *General page,* an indication of the date of last calibration appears along with an exclamation point symbol:



Comming calibration at the module tab

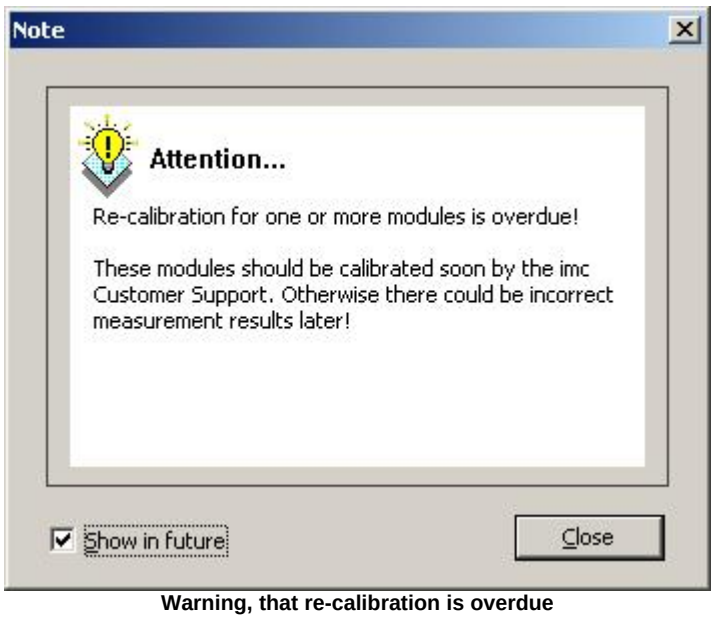
Upon initiating configuration, there is also an entry in the Information window:


Configure CANSAS-Modules
CANSAS modules
Configuration steps
The following CANSAS modules are being configured :
UNI8_870983
Checking the configurations
Connecting to the CANSAS module
Loading configuration to CANSAS module
Setting the configuration in the CANSAS module as permanent
Configuration of the CANSAS module completed successfully.
Re-calibration of the module is due soon!
Close
UNI8_870983 : Re-calibration of the module is due soon!

Hint for comming calibration during configuration

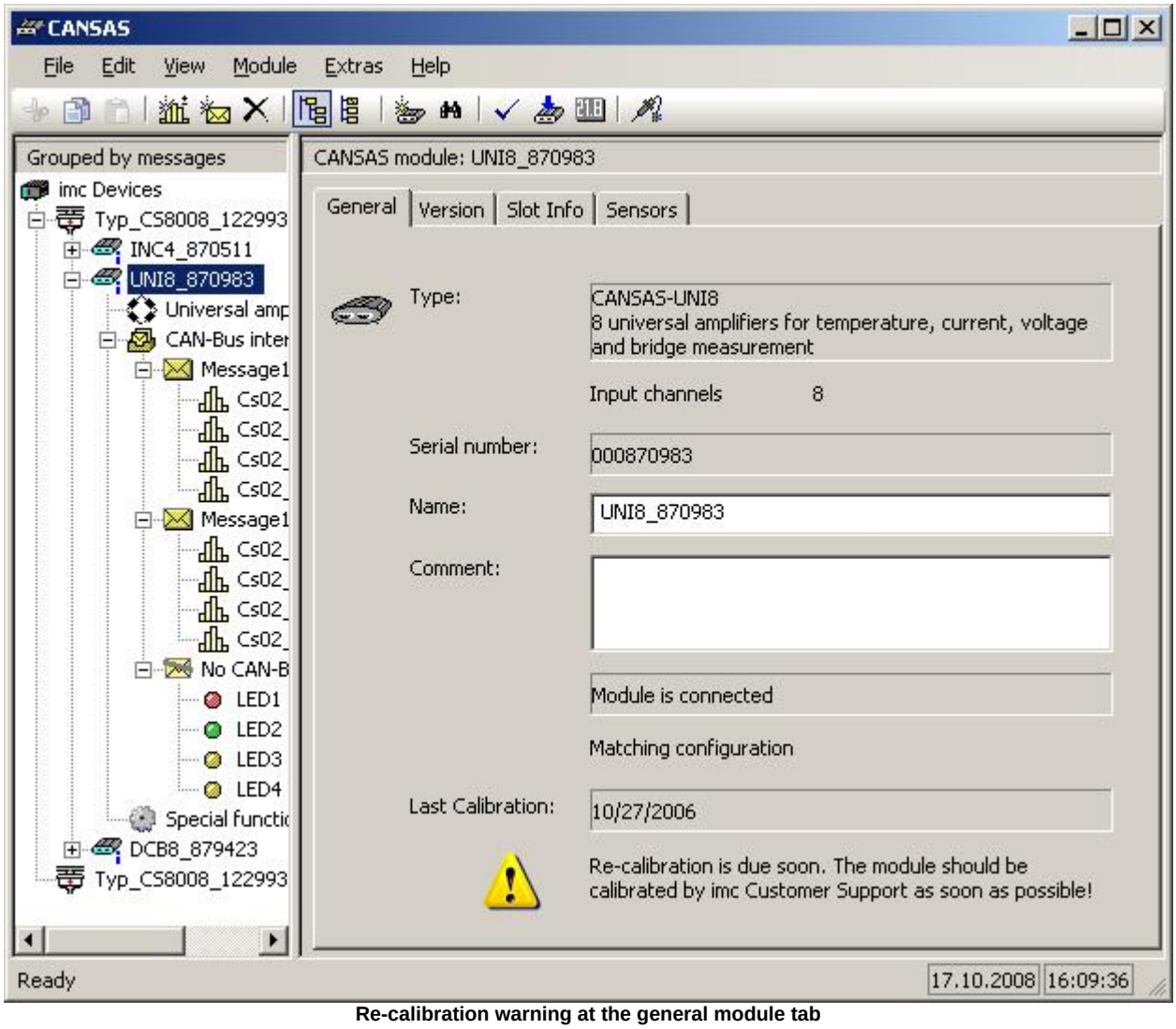
5.7.2 Recalibration overdue

When a new module is integrated into the system, the following message appears if the calibration validity has expired:


Note
Attention...
Re-calibration for one or more modules is overdue!
These modules should be calibrated soon by the imc Customer Support. Otherwise there could be incorrect measurement results later!
Show in future
Close

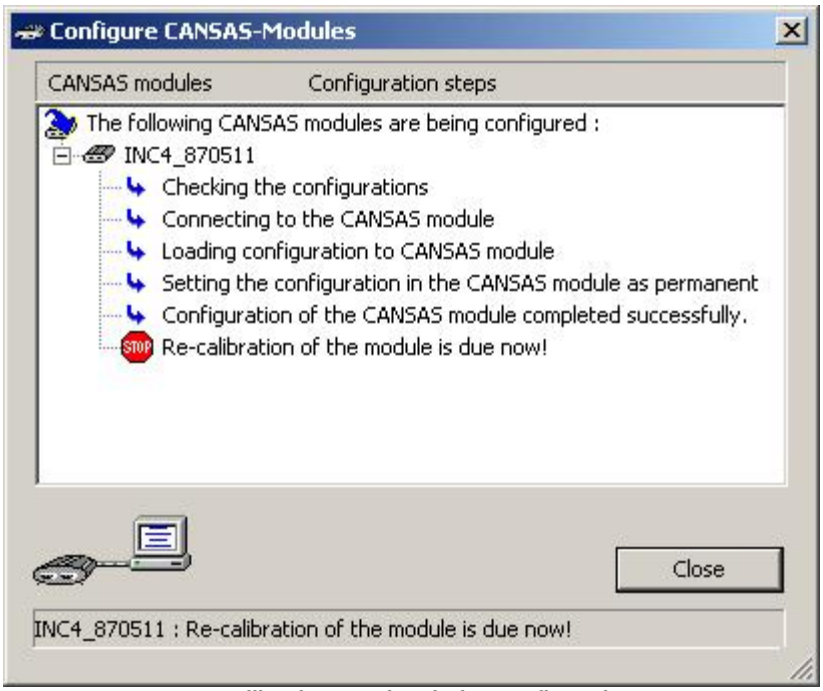
Warning, that re-calibration is overdue

On the module's *General page,* an indication of the date of last calibration appears along with an exclamation point symbol:



Re-calibration warning at the general module tab

Upon initiating configuration, there is also an entry in the Information window:


Configure CANSAS-Modules
CANSAS modules
Configuration steps
The following CANSAS modules are being configured :
INC4_870511
Checking the configurations
Connecting to the CANSAS module
Loading configuration to CANSAS module
Setting the configuration in the CANSAS module as permanent
Configuration of the CANSAS module completed successfully.
Re-calibration of the module is due now!
Close
INC4_870511 : Re-calibration of the module is due now!

Re-calibration warning during configuration

5.8 TEDS

5.8.1 TEDS: Plug & Measure functionality for sensors

When connecting classic sensors such as strain gauges, thermometers or power meters to measurement devices, the user requires knowledge of sampling rates, scaling factors, units, etc. in order to be able to obtain the desired measurement results.

An additional problem is posed by the task of taking measurements of large-scale installations with high channel counts. In settings where there can be up to hundreds of measurement locations, for instance on board trains or planes, or for more complex measurements of road vehicles, extra difficulties can arise from the increased likelihood of incorrect connection of sensors to channels, or of incorrect device settings. Getting sensors mixed up is, unfortunately, a familiar situation.

For all these reasons, imc is now introducing an electronic data sheet which can be retrofitted to all commercially available sensors and which eliminates the problems spelled out above.

5.8.1.1 How can measurement be simplified for the user?

Complex, multifunctional user interface for making device settings are needed only in exceptional circumstances. The necessary parameters for making the measurement device's settings are recorded in "electronic spec sheets" linked to the sensors to be connected. The measurement device is able to both read and process these data, which are stored in so-called Transducer Electronic Data Sheets (TEDS). The sensor settings are made by the company's own measurement specialists.

This makes it possible for the measurement devices to be operated reliably by personnel less qualified in measurement engineering.

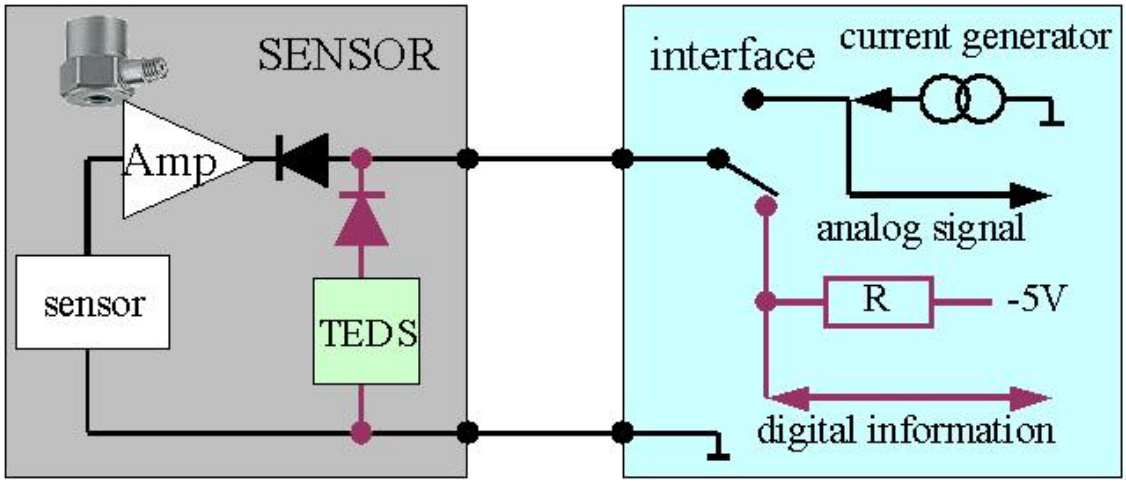
Ideally, the following conditions are provided:

- All data relevant to measuring with a particular sensor (e.g. the sensor's preferred sampling rate) are contained in the electronic spec sheet linked to it,
- all sensors already present can be equipped with such an electronic data sheet,
- the user can connect the sensor at ***any*** input of an all-purpose measurement device,
- the user can ready the measurement system for operation at a single mouse-click, without needing skills in using a complex software interface, much less in actual programming,
- sensors can be interchanged without causing the entire measurement system, e.g., as a test station component, to require re-calibration.

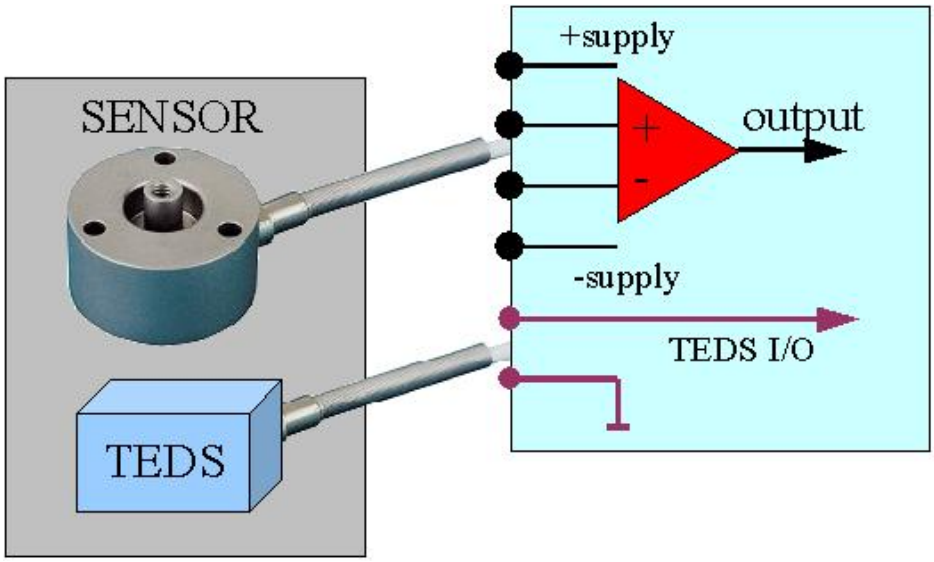
5.8.1.2 Steps Towards Achieving "Plug & Measure" Functionality

In the draft for the standard IEEE P1451 /**1**/, the standardization committee sets out the definition for a so-called "smart sensor". It's based on a TEDS which contains all information about the sensor available. This information can be used once the sensor has been connected to the measurement device. P1451.4 defines a so-called "mixed-mode interface", according to Class 1 both the sensor's measurement signal and TEDS-data can be carried on the same line.

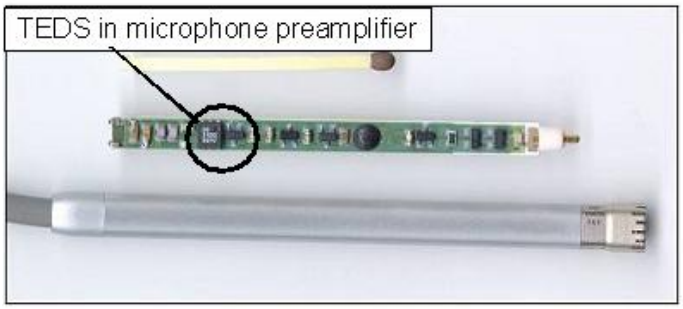
- A "Mixed Mode Interface" sends/ receives TEDS data and receives analog signals.
- Class I interfaces are designed for constant-current-fed piezo-electrical sensors and use these sensors' quasi-standard (integrated electronic piezoelectric [IEPE] transducer).
- Class II interfaces are designed for bridges and other sensors.

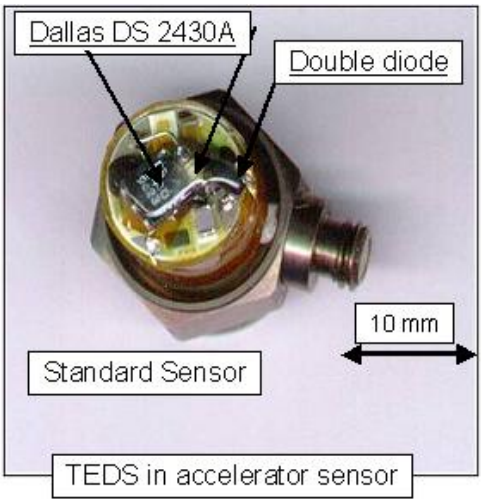


A Class I Mixed Mode Interface receives/ sends TEDS data and analog signals on the same line



A Class II Mixed Mode Interface receives/ sends TEDS data and analog signals on different lines. The sensor is not influenced.





The digital part of a TEDS interface is based on the 1-wire protocol of the company Maxim/Dallas, a simple serial Master-Slave protocol. The sensors could be for instance the EEPROMs – DS2430 (256 b) and DS2433 (4 Kb).

Naturally, sensor recognition only makes sense if the connected measurement devices are able to both read and process the sensor's characteristic data. With *Plug & Measure* you are able to equip ***every*** commercially available sensor with TEDS.

Most sensors used today (almost 100%) have no sensor recognition.

Another hurdle on the way to fulfilling the vision is the fact that certain sensors require customized signal processing. This means that it's not possible to assign just any sensor to just any input of a standard measurement device. In other words, not every sensor has a voltage output, but some require processing or a supply source. The newest generation of devices, which includes UNI8, confronts this dilemma by equipping every measurement channel to be able to measure every signal type, whether voltage, current, temperature using thermocouples or resistance thermometers or even measurement bridges or strain gauges. In other words, each channel is an all-purpose channel for practically every kind of physical measurement quantity. This approach does make each individual channel more expensive than a channel dedicated to just one quantity, but the enormous resulting advantages pay for themselves.

While constructing a measurement setup (positioning the sensors, cabling, and making settings for the measurement device) once required the skills of an experienced measurement engineer, the new automatic sensor recognition concept enables less qualified personnel to perform the procedure. Once a sensor has been positioned, it can be connected at any unoccupied channel of the measurement system. The particular channel and its number are no longer important, but rather the sensor's name as recorded in the sensor recognition. For the user, it doesn't matter to which physical channel a sensor was connected, since he's usually only interested in the channel's name (e.g. Velocity_FrontWheel_Left) and the physical assignment to a measurement channel is unimportant if every channel is identical.

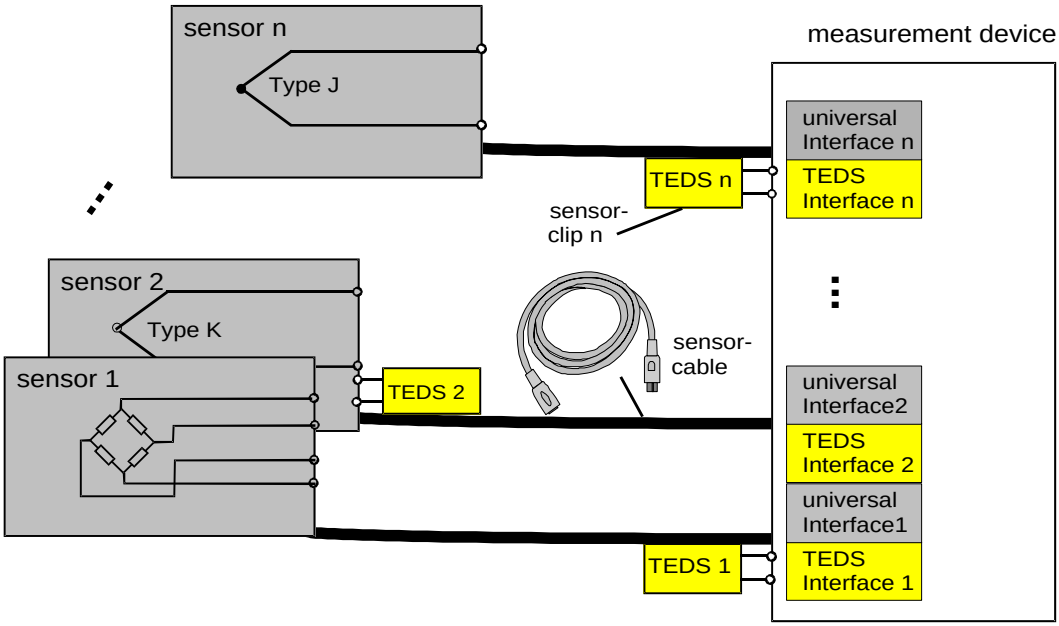
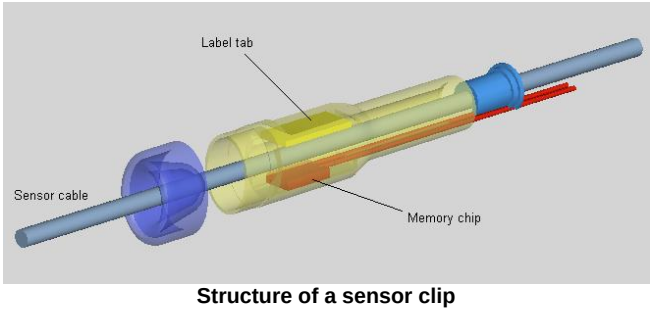


Fig 2: Sensors with freely assigned TEDS. The measurement device consists of n all-purpose sensor interfaces. The retrofitted TEDS can be connected either at the sensor (TEDS 2) or at the measurement system. the measurement channels are appropriate for practically any sensor, so that the sensors can be connected to any unoccupied input on the device.

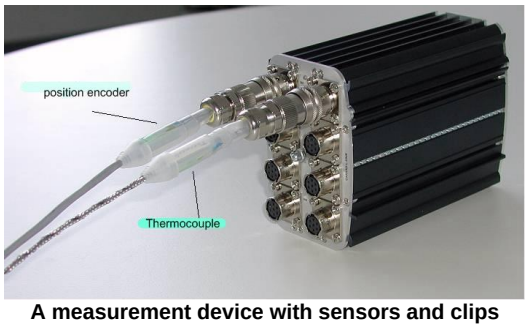
5.8.1.3 Sensor database

The simplest way to avoid repetitiously setting sensors is to build a database into the measurement device which contains all information about the sensor. imc's sensor database *imc Sensors* is the ideal counterpart for *Plug & Measure.* How the database, TEDS and *imc Devices* work in concert is described in the manual *imc Devices.* For details on the sensor database, see the manual *imcSensors*.

Setting a measurement device with a single configuration command



Structure of a sensor clip



A measurement device with sensors and clips connected

The measurement device independently adopts the appropriate settings upon receiving a single configuration command. All information relevant to settings is recorded in the sensor's TEDS. If the configuration command "Configure System" is called, then all the data needed for making the device's settings are read out of the respective EEPROMS assigned to the sensors and the measurement device, including its signal conditioning, is correctly configured. Of course, there are parameters, which are to be set in the device itself, but which also can be saved to the sensor-TEDS. These include the measurement duration or the location for data storage. And of course, a user's interface is still needed, by which the sensor's settings data can be subsequently edited.

Another great advantage would result from the ability to not only retrofit sensors with TEDS but to also to file sensor characteristics in a database. However, this requires a PC having the appropriate database for making settings to the measurement device.

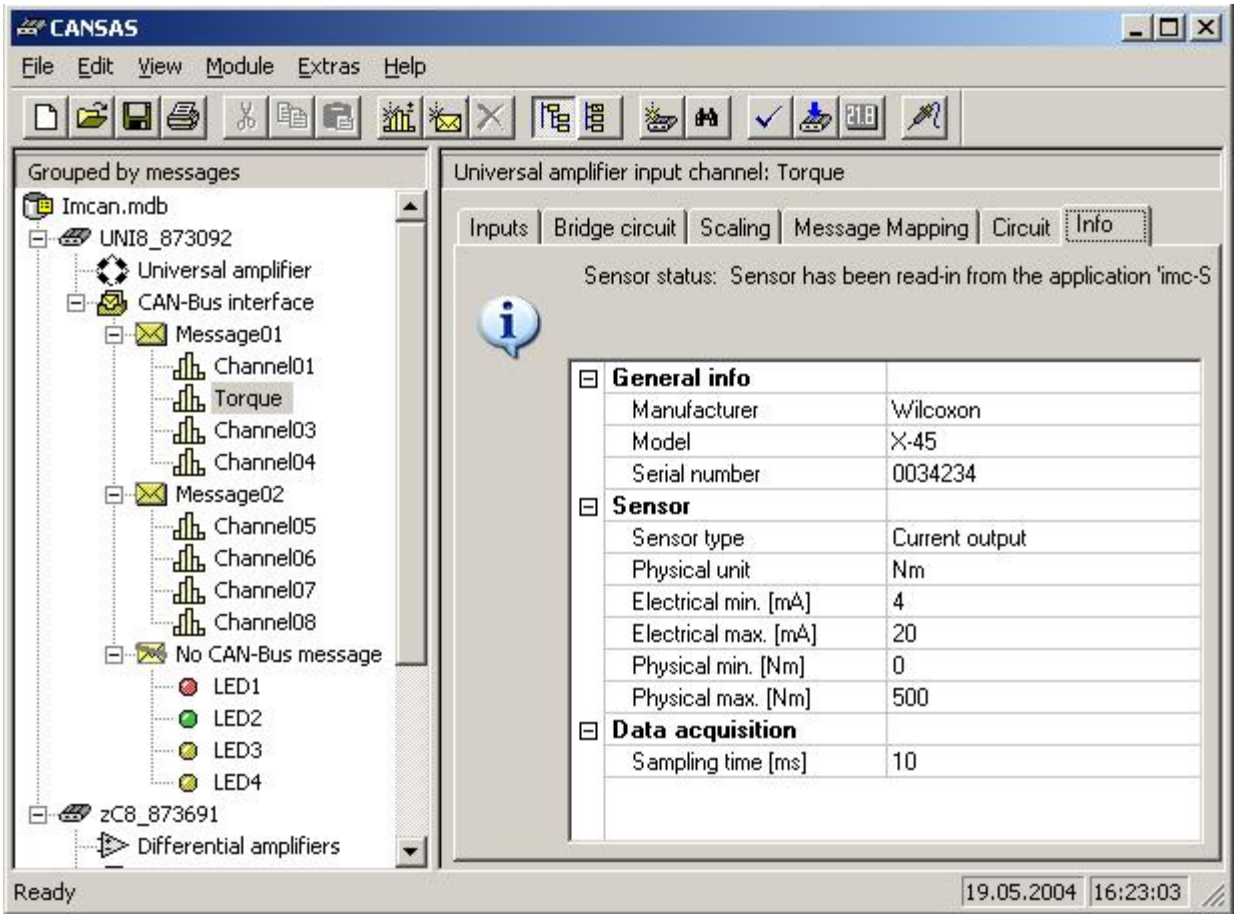


Fig. 4: An excerpt of the sensor description for a measurement channel connected to the CANSAS UNI8 module. the data are saved as an XML-file in the TEDS and can be called at any time. Along with sensor-specific data, the necessary channel-specific data (e.g. the sampling rate) are also noted.

The features presented above have already been implemented in already available measurement modules

belonging to the CANSAS series. These include a pressure module, having eight built-in pressure cells, and the module UNI 8 with eight uniform measurement inputs which support practically all sensors for physical measurement engineering. Both modules digitize the data they capture which they then transmit via the CAN-bus.

In the pressure module, the sensor characteristics are already built into the sensor. Since the sensor itself fits inside the pressure interface nipple, a very compact design is required. If one or more sensors fail, they can simply be replaced. The replacement sensors automatically announce to the measurement device their characteristic data. Thus the measurement device resumes its state of readiness without needing re-calibration. The measurement device's uncertainty is added to the sensor uncertainty.

The second possibility is the clip-on pod, shown above, which contains the chip on which the sensor information is recorded. This solution is available for practically any sensor and turns a conventional sensor into a "smart sensor".

Sensors which already contain a PROM and can operate as per IEEE P1451.4 can also be connected to CANSAS UNI8.

Naturally, the user of this new kind of measurement engineering has direct access to the measurement device's settings via a conventional user interface. For example, if a sensor's TEDS states 500 Hz as its sampling rate, but the user wants to sample at 1 kHz, he can simply make and save this setting by means of the user interface.

Another important aspect is the compatibility of the imc solution and any sensors having TEDS which are already present. Thanks to the specifications by IEEE 1451, all information stored in these sensors can also be used by imc devices. Such settings parameters which don't appear in the TEDS, such as the sampling interval, can be set later using the imc devices' operating interface.

Fig. 5: Pressure sensor with built-in TEDS sensor recognition

Fig. 6: 8-channel CANSAS-P8 pressure measurement module. Even if sensors are exchanged, the overall system remains calibrated.

5.8.2 Operation in CANSAS Software

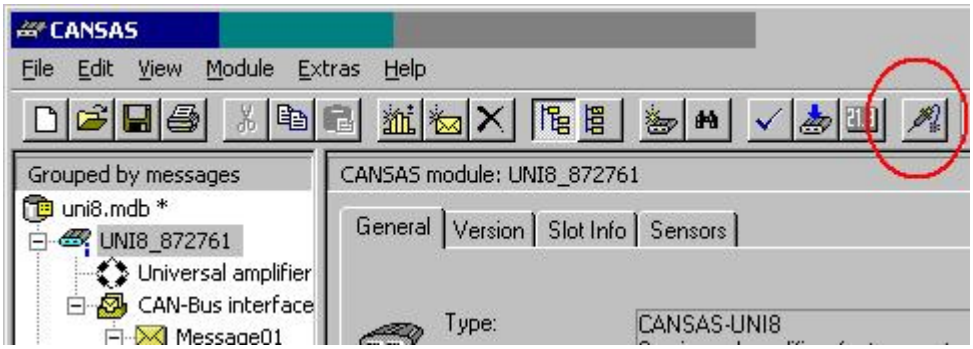
The device software supports export of sensor spec-sheet data from a sensor TEDS and the application of this information in configuring channels.

Sensor TEDS are supported by the amplifier *UNI8, CI8, SCI8, SCI16, SC16, DCB8, P8* and all futurities.

For configuring the sensor information, you need the product *imc Sensors*. The use of this sensor database in *CANSAS* is described here 205. For a detailed description of the database itself, see the user's manual for *imc Sensors*. Below, the import of already recorded sensor data to *CANSAS* is described.

5.8.2.1 Importing sensor data

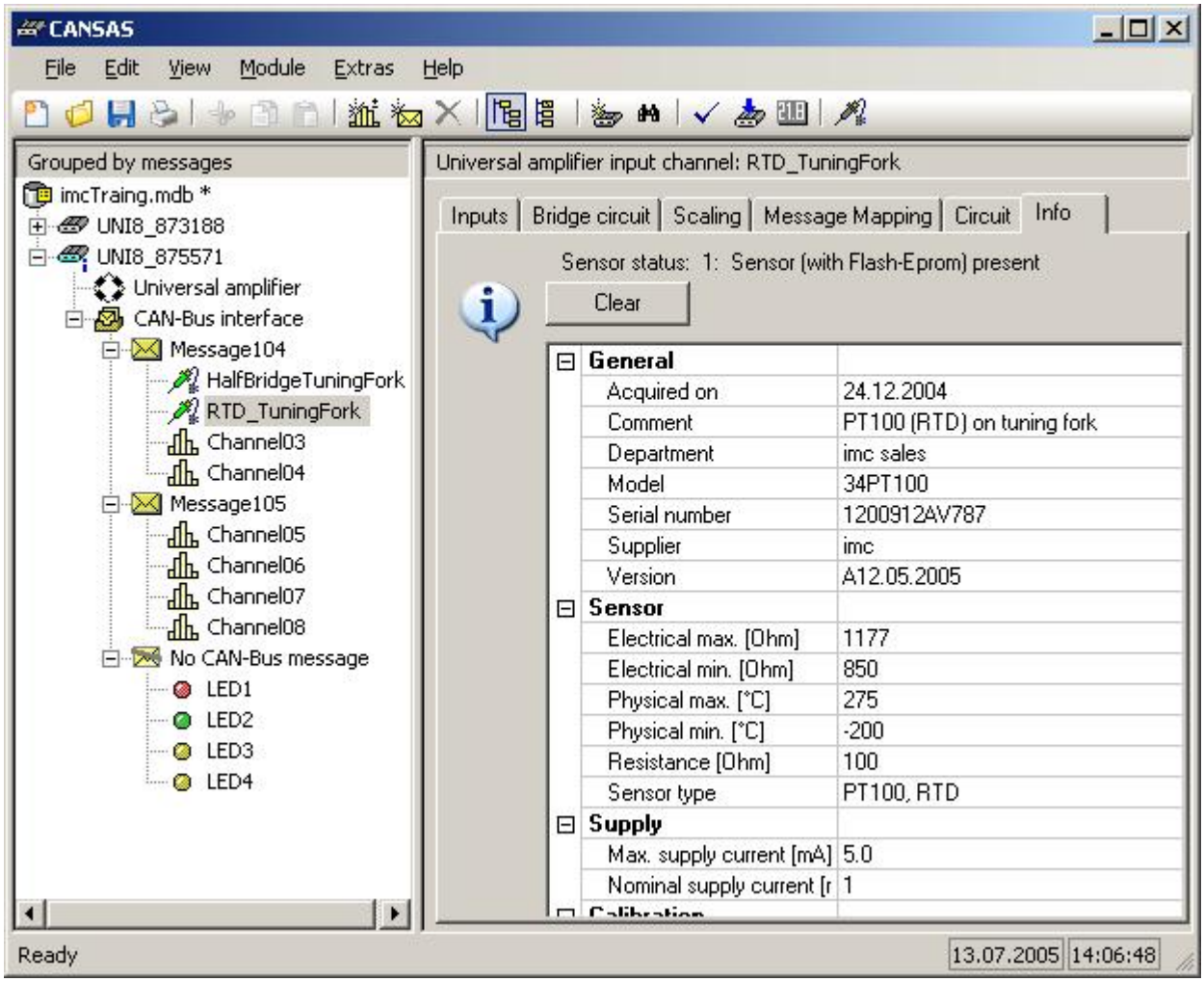
Import of Import of sensor spec-sheet data from all sensor TEDS takes place on menu item *Module* ⇒ *Sensor* ⇒ *Read characteristic values (from Sensor-Eprom)…;*alternatively corresponding toolbar button:



The sensor information is read out and used to configure the channels. TEDS- channels will be marked with a symbol.

5.8.2.2 Sensor information

The dialog page *Sensor* presents a detailed list of the selected sensor's technical specs. However, these sensor data cannot be edited here!



Note

In order to be able to edit the sensor spec-sheet data, the program *imc Sensors* must be installed. The sensor database *imc Sensors* administers such information for sensors. In this program, it's possible to set up, edit and administer entries for sensors; see Sensor-Database 205.

5.8.2.3 Saving imported sensor information in CANSAS

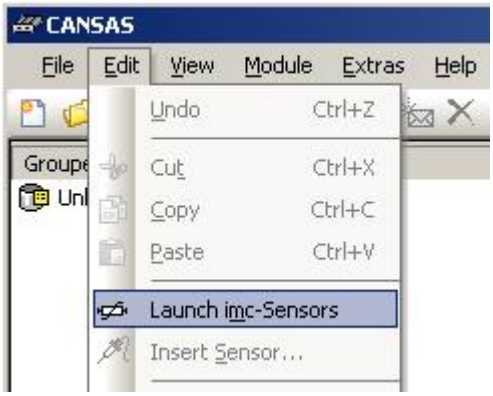
The sensor information once imported and linked to a channel are **saved with the CANSAS configuration**. If the configuration is later transferred (e.g. copied to another PC), this sensor information isn't lost!

5.8.2.4 Sensor-Database

The device software supports the export of sensor information from a sensor database and the application of this information to configure measurement channels.

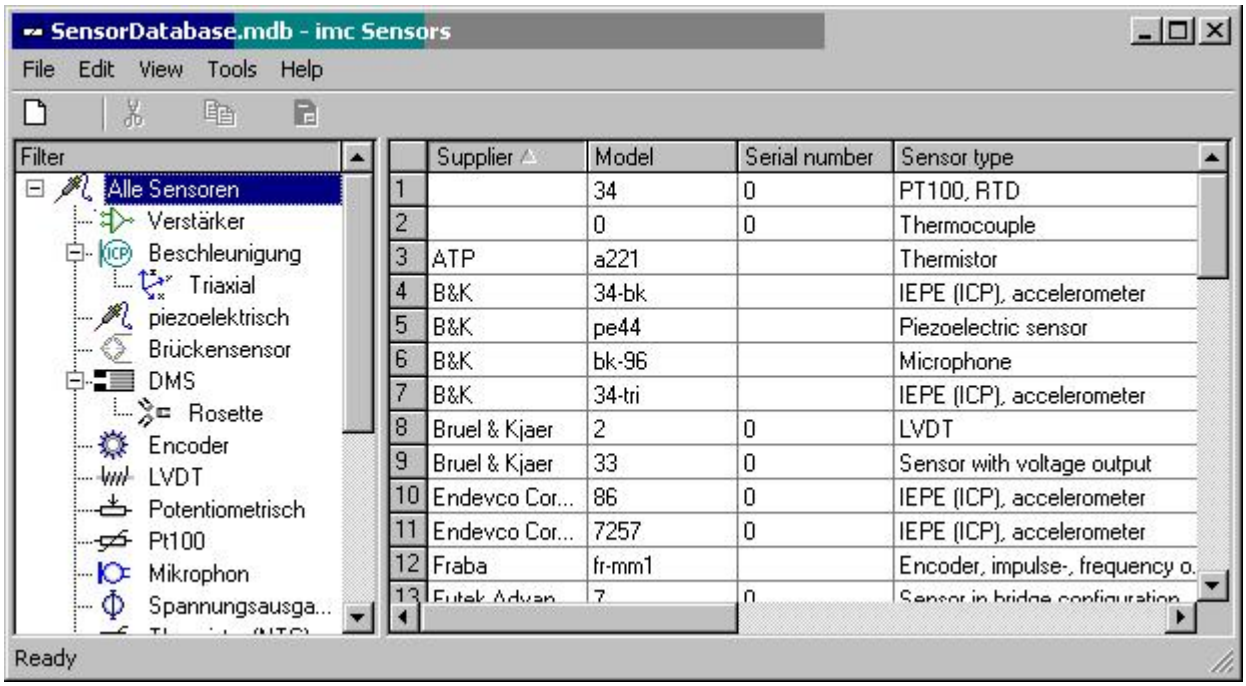
For this purpose, it's necessary to install the product *imc Sensors*. The sensor database *imc Sensors* administers the sensor information. Sensor entries can be created, edited and administered.

5.8.2.4.1 Importing sensor information from the sensor database

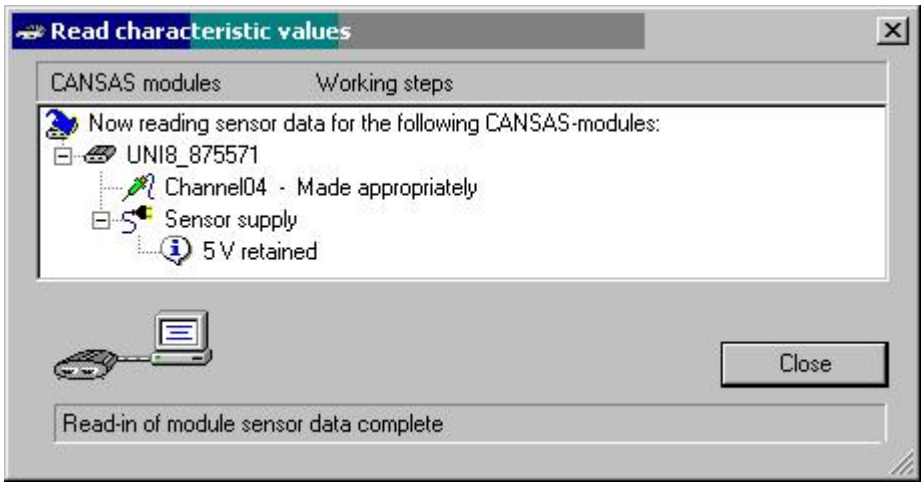


If *imc Sensors* is installed, the sensor database can be started either via the menu item *Edit* ⇒ *Start imc Sensors...* or by clicking on the corresponding button in the toolbar.

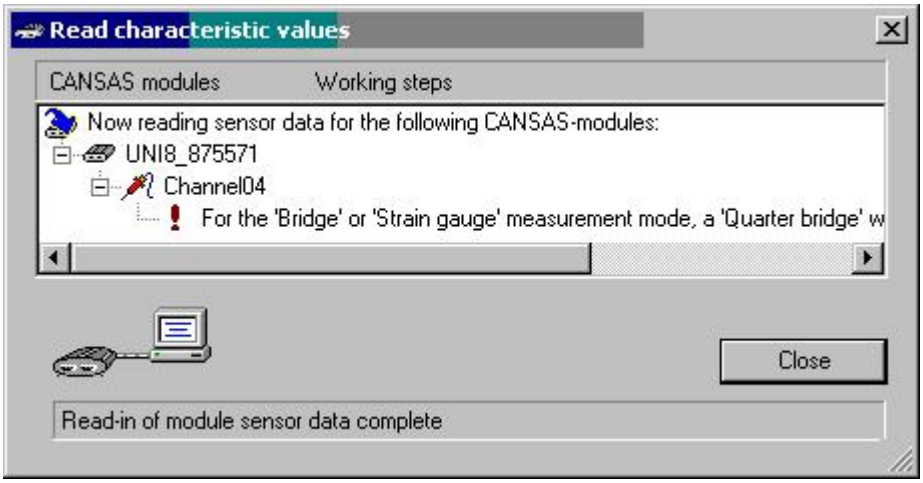
Once the desired sensor has been selected, the sensor information can be applied to the desired channel by means of Drag & Drop.



Alternatively, the CANSAS menu item *Edit* ⇒ *Insert sensor...* can be used. Therefore *imc Sensor* has to be started and a sensor is selected.



The sensor information is only applied if the channel supports the corresponding properties. Otherwise, an error message is posted:

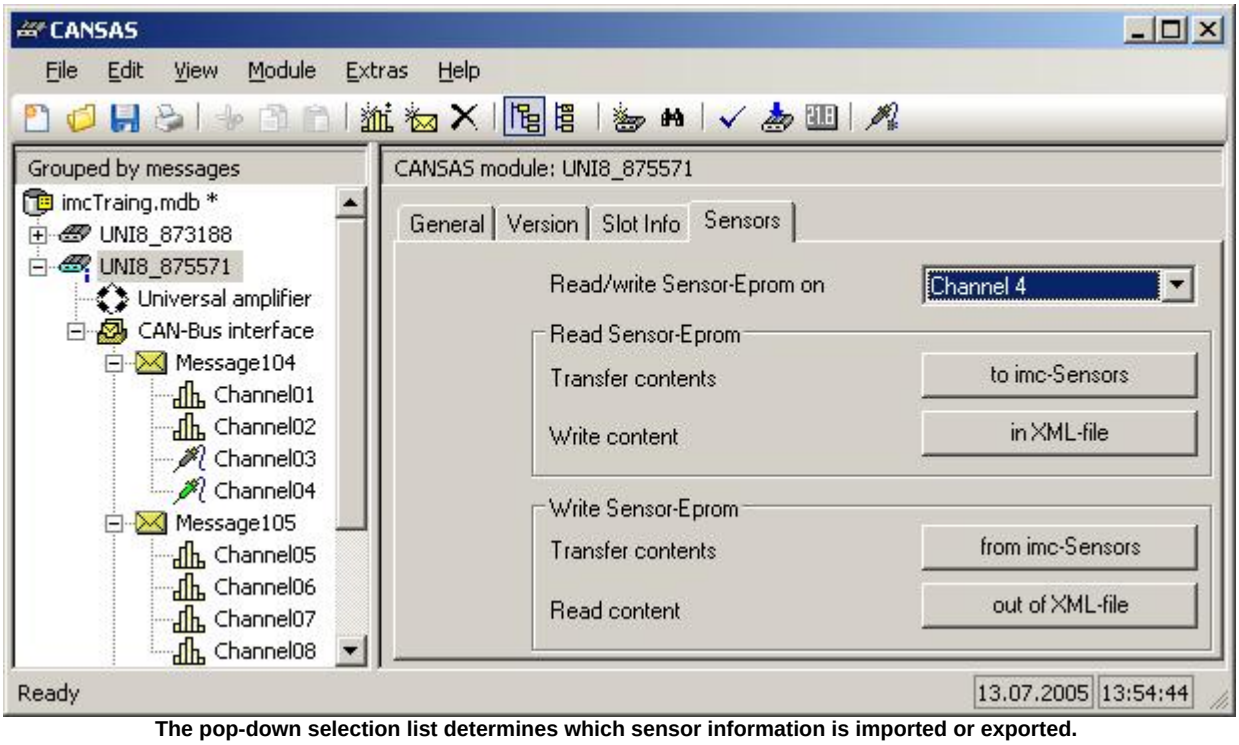

Read characteristic values
CANSAS modules
Working steps
Now reading sensor data for the following CANSAS-modules:
UNI8_875571
Channel04
For the 'Bridge' or 'Strain gauge' measurement mode, a 'Quarter bridge' w
Close
Read-in of module sensor data complete

Notes to characteristic curves

- When importing characteristic curves from TEDS or imcSensors to CANSAS, the characteristic curve may not comprise more than 60 measured points. If an attempt is made to import a characteristic curve with more than 60 measured points, a corresponding error message appears.
- As of CANSAS Version 1.6R6, characteristic curves are also accepted if the curve's X-values decrease strictly monotonically. Previously, only characteristic curves with strictly monotonically increasing X-values were permitted.

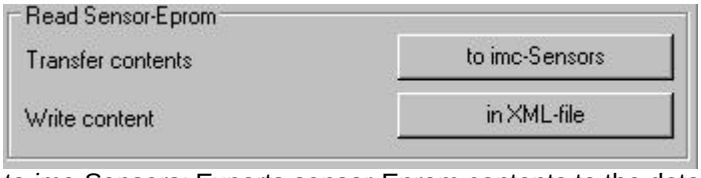
5.8.2.4.2 Exchanging sensor information between the sensor-Eprom and sensor database

With a module selected in CANSAS, the *Sensors* page in its dialog appears as follows:



The pop-down selection list determines which sensor information is imported or exported.

5.8.2.4.3 Read Sensor-Eprom



to imc-Sensors: Exports sensor-Eprom contents to the database *imc Sensors*. *imc Sensors* must be already open.

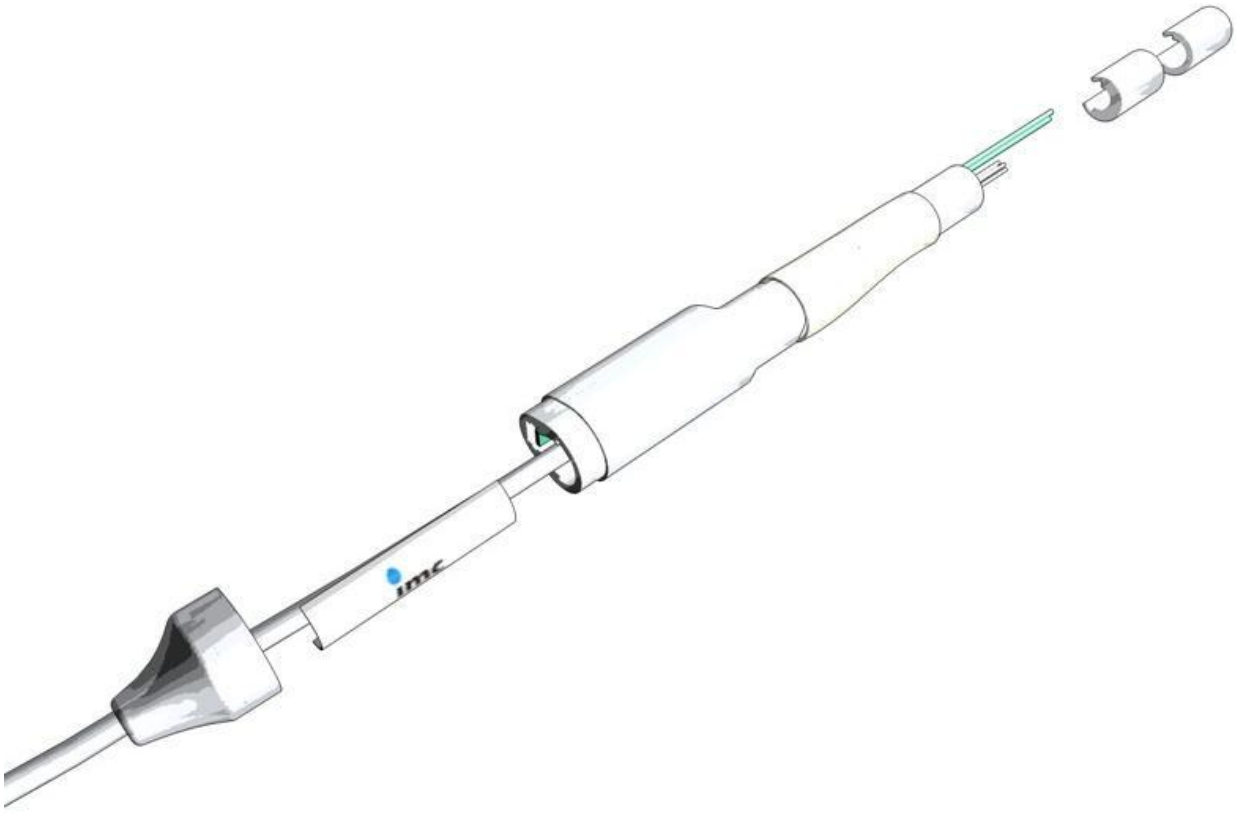
to XML-file: Exports information from sensor-Eprom and saves it to a file in XML-format. By this means, information from individual sensors can easily be exchanged.

5.8.2.4.4 Write Sensor-Eprom

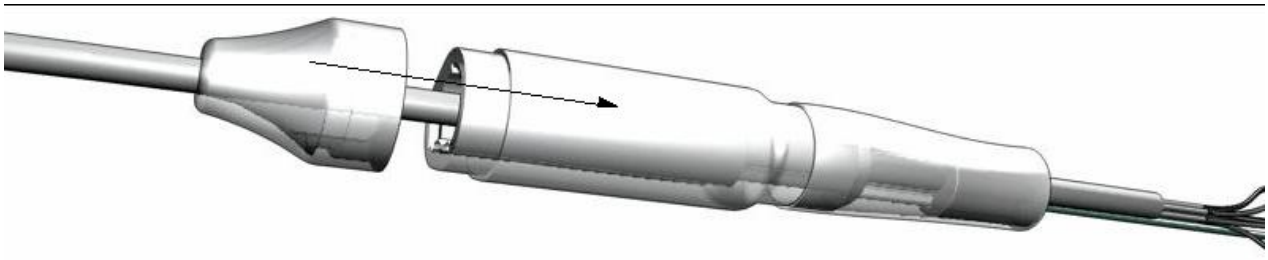
from imc-Sensors: The database *imc Sensors* is open and a sensor is already selected. The information on the selected sensor is written to the sensor Eprom.

out of XML-file: Sensor information stored in an XML-file is written to the sensor Eprom.

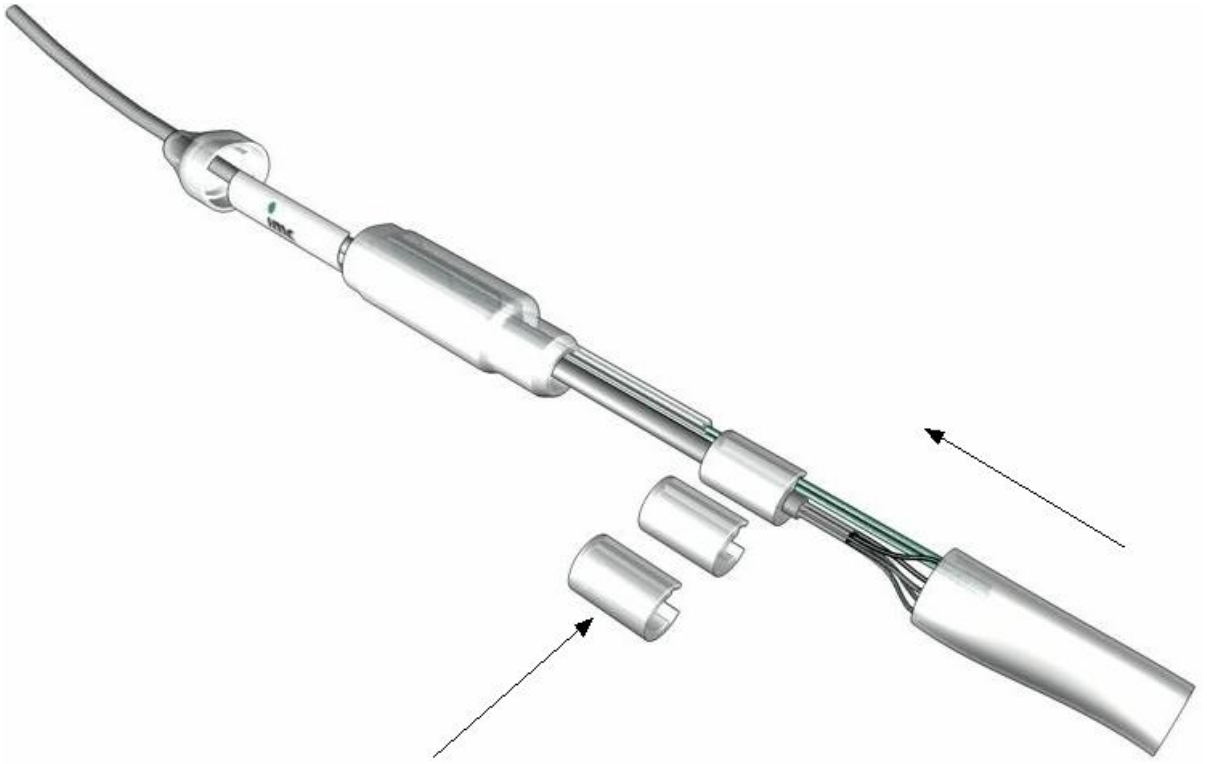
5.8.3 Plug & Measure - Assembly of the sensor clip



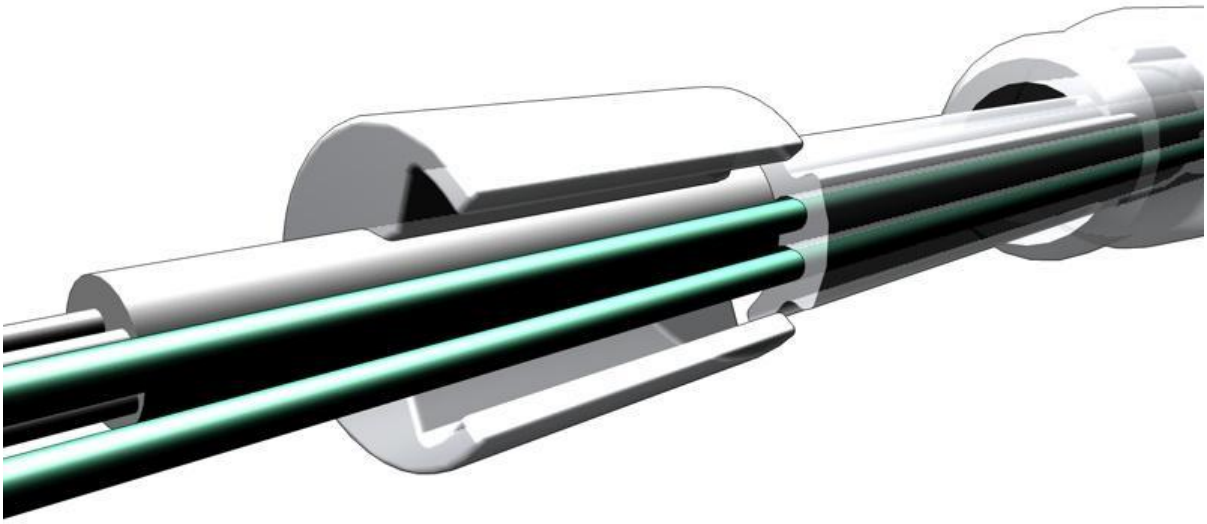
Thread all parts of the Plug & Measure sensor clip to the cable

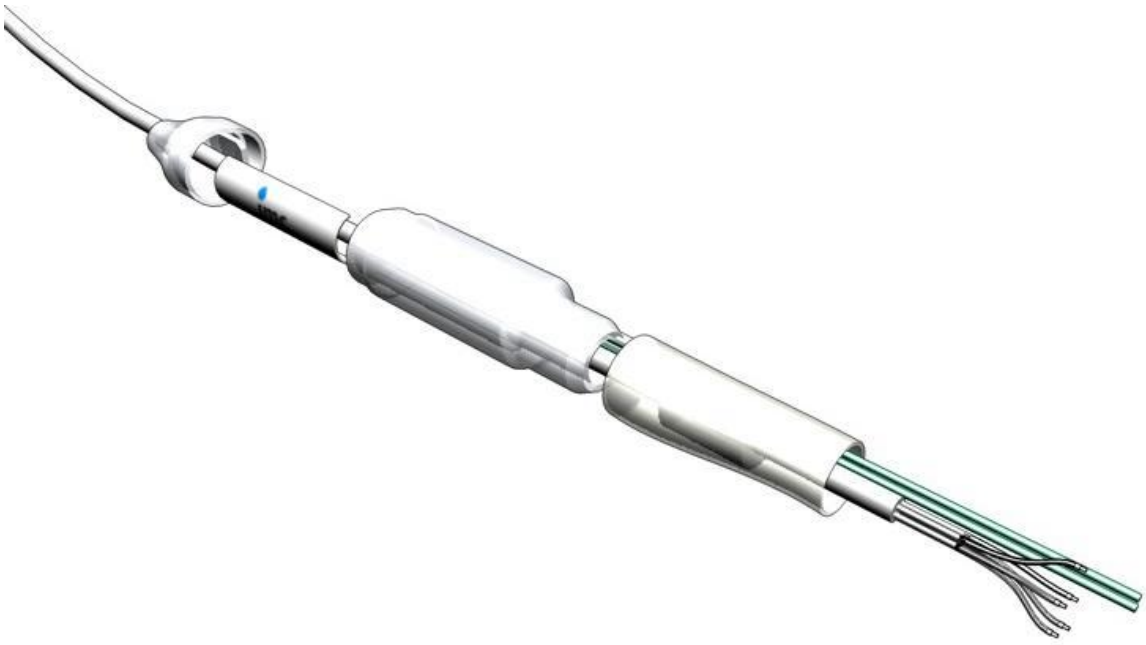


Insert the written label into the housing. Put on the cap.



Put on the adaptation tube for the matching cable to the groove from the housing.

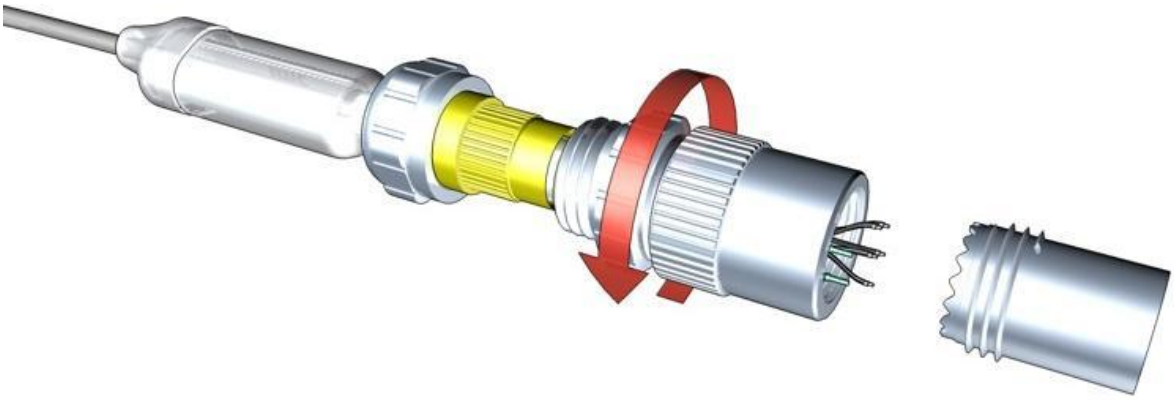




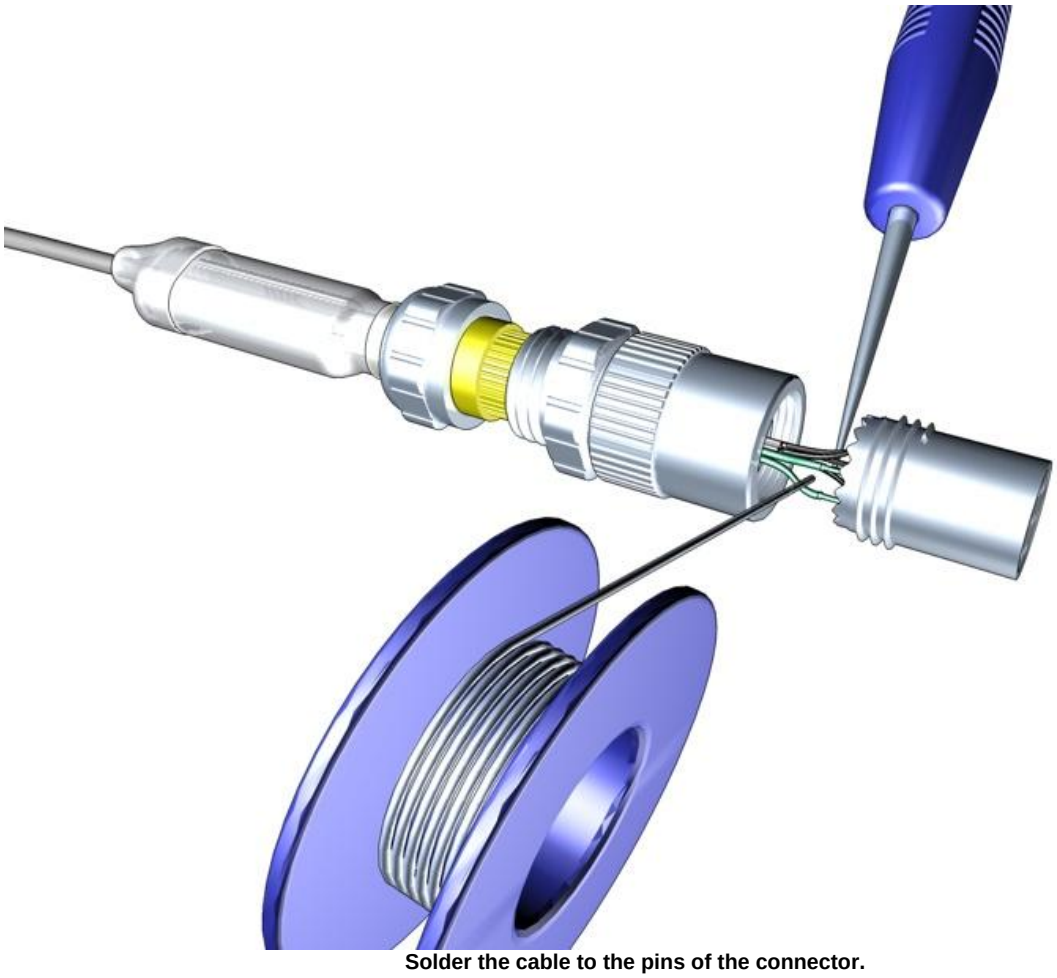
Cover the adaptation shell by the silicone tube over the base of the housing. Adjust the adaptation shell inside the silicone tube.

5.8.3.1 Assembly of the ITT-VEAM plug (UNI8)

Move the crimp gasket over the silicone tube.

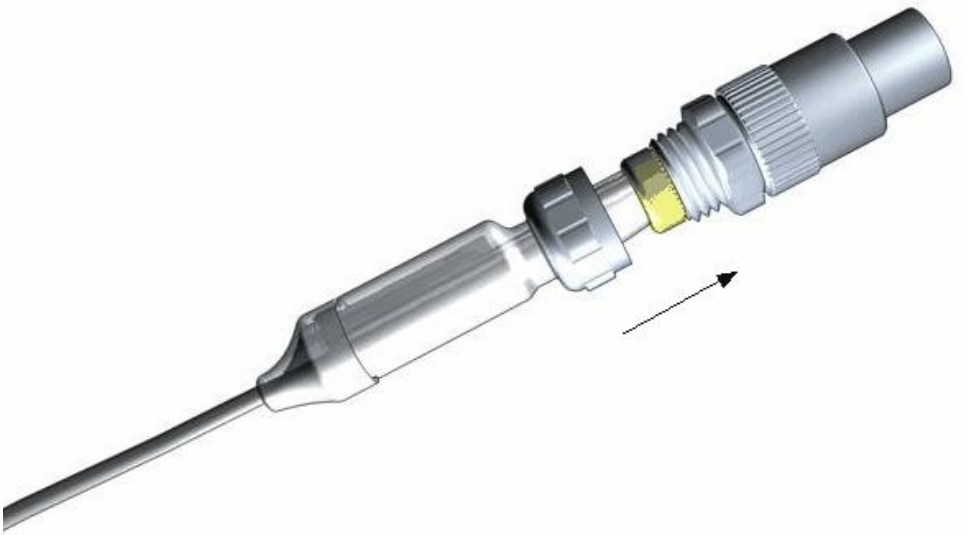


Screw together the connector and move them close to the crimp gasket.



Solder the cable to the pins of the connector.

Remove the connector and screw them to the plug.



Bring together all parts and fix them with the screw cap.

Properties of the Modules

CANSAS modules are used to set up decentralized measurement networks. This means they can be stationed at different locations near the processes they measure. Depending on the overall channel count, this can be accomplished with stand-alone modules or, for instance, in racks within test rigs.

In especially harsh conditions, the setup will include the CANSAS-SL modules. These can operate in a broad range of ambient temperatures, can withstand strong shock (MIL STD810F) and feature a high protection rating water resistance (IP65).

Type	Module name CANSAS/	Channels per module	Max. sampling rate per channel	Bandwidth	Remarks
strain gauge (DMS), bridge	BRIDGE2 217	2	5 kHz	1 kHz	
GPS	CANSER 227	1	-	-	NMEA protocol
voltage, temperature.	C12 228	12	500 Hz	200 Hz	current with shunt plug
voltage, temperature	C8 231	8	100 Hz	20 Hz	current with shunt plug
voltage, temperature (isolated), resistor	CI8 238	8	1 kHz	440 Hz	current with shunt plug
analog outputs	DAC8 247	8	5 kHz	5 kHz	
strain gauge (DMS), bridge	DCB8 253	8	1 kHz	200 Hz	
digital inputs	DI16 259	16	10 kHz	10 kHz	
digital outputs	DO16 263	16	10 kHz	10 kHz	
relay outputs	DO8R/DO16R 266	8 / 16	125 Hz	125 Hz	
voltage, current, temperature (isolated), resistor	HCI8 292	8	1 kHz	440 Hz	
ignition angle sensor	IGN 267	3	200 Hz	500 kHz	
incremental encoder	INC4 286	4	1 kHz	500 kHz	
voltage, temperature (isolated)	ISO8 291	8	500 Hz	200 kHz	current with shunt plug
pressure	P8 298	8	1 kHz		
pulse width mod.	PWM8 313	8	33 Hz to 10 kHz	10 kHz	
voltage, temperature	SCI8, SCI16, SC16 318	8 / 16 /16	1 kHz / 500 Hz	42 Hz / 23 Hz / 28 Hz	
voltage, temperature, current, bridge, resistor	UNI8 333	8	1 kHz	200 Hz	
voltage	µ-CAN-V1 355 µ-CAN-V4 375	1 / 4	2 kHz	840 Hz	
temperature	µ-CAN-T1 363 µ-CAN-T4 376	1 / 4	100 Hz	20 kHz	
bridge	µ-CAN-B1 365 µ-CAN-B4 377	1 / 4	2 kHz	840 Hz	
CAN-HUB	µ-CAN-HUB4 378	4	-	-	

Modul name CANSAS/	from CANSAS version	CANopen® from version	TEDS from version	Remark
BRIDGE2 217	1.3 .R16	-	-	
CANSER 227	1.2 R8	-	-	
C12 228	1.3.R16	-	-	
C8 231	1.4 R11	-	-	SL-C8-AS (1.5.2)
CI8 238	1.4 R10	1.5	1.5 R12	Layout 3 (1.5 R12) L-CI8-2T-CD (1.5 R13) SL-CI8-AS (1.5R9)
DAC8 247	1.2 R8	1.6 R6	-	
DCB8 253	1.4 R13	-	1.4 R13	SL-DCB8-L (1.5 R13)
DI16 259	1.2 R8	1.6 R6	-	
DO16 263	1.2 R8	-	-	
DO8R/DO16R 266	1.2 R8	1.6 R6	-	
HCI8 405	1.6R11	1.6R12	1.6R11	TEDS with customer connector only
IGN 267	1.7	-	-	
INC4 286	1.2 R8	1.6 R6	-	SL-INC4-AS (1.5.2)
ISO8 291	1.3.V16	-	-	
P8 298	1.2 R8	-	1.2 R8	
PWM8 313	1.3 R9	-	-	
SCI8, SCI16, SC16 318	1.3 R19	1.6 R6	1.4 R6	K-SCxy (1.4R6) SL-SCI16-2T (1.5R4)
UNI8 333	1.2 R8	-	1.2 R8	SL-UNI8-L (1.5 R13) UNI8-MÖWA (1.5 R13)
µ-CAN-V1 355, µ-CAN-V4 375	1.5 R8	1.5 R10	1.5 R8	
µ-CAN-T1 363, µ-CAN-T4 376	1.5 R8	1.5 R10	1.5 R8	
µ-CAN-B1 365, µ-CAN-B4 377	1.5 R8	1.5 R10	1.5 R8	
µ-CAN-HUB4 378	1.5 R8	-	1.5 R8	

Note

- For CANopen and TEDS, CAN base board 2 is required.
- Please see also the notes at Feature and modules 192

6.1 BRIDGE2

2-channel bridge amp.

Parameter	Value (typ. / max).	Remarks
inputs	2	1 channel each on DSUB-15 socket
measurement mode	DC-bridge measurement	

Technical data BRIDGE2. 383

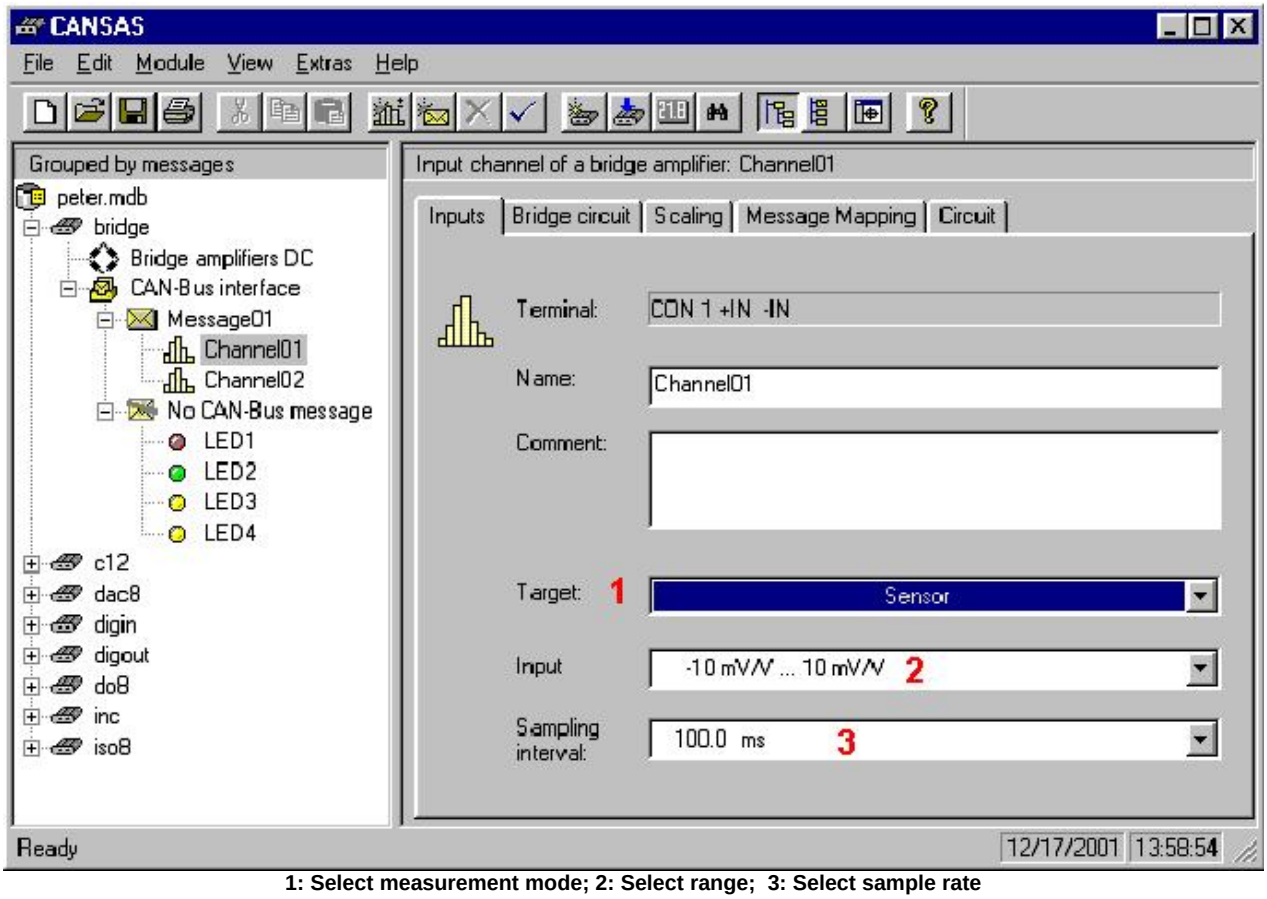
CANSAS-BRIDGE2's two bridge channels have a DC bridge excitation voltage of 3,5 V. Any **initial imbalance** (offset) of the measurement bridge, which can be as large as multiples of the input range, **can be balanced**

Setting the operating mode (for each bridge channel separately):

Channel0x → Index card "Inputs" → Combo box "Target"

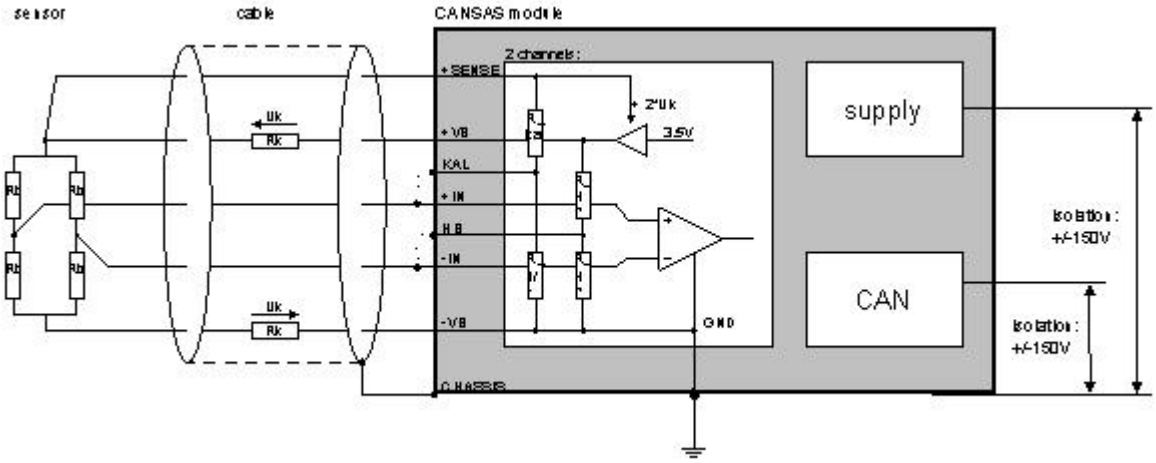
Setting the bridge configuration:

Channel0x → Index card "Bridge circuit" → Combo box "Bridge configuration"



1: Select measurement mode; 2: Select range; 3: Select sample rate

Block diagram



Note

- It is not enough to connect a differential voltage between +IN and -IN. The operational amplifier only works properly if its reference ground (GND) isn't open, but rather connected. This is ensured when a bridge which CANSAS provides with bridge excitation is connected, since -VB is at GND.
- A reference ground must be established in the measurement chain. There are various techniques as well as considerations. In some arrangements, grounding the sensor is preferred, in others, grounding the measurement system (CANSAS chassis). Either way, ground loops must be avoided.
- Grounding is also recommended as a way of avoiding the buildup of high or dangerous potential differences between exposed conducting parts (such as the chassis) and ground.
- The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN-bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.

6.1.1 DC- bridge readings (measurement target: Sensor)

The amperage rating of CANSAS-BRIDGE2's voltage source allows connection of **120Ω measurement bridges in all ranges.**

The **terminal +Sense** serves to compensate voltage drops along long cables, which would otherwise distort the readings made. It is used to close the control loop which ensures the required bridge voltage is available exactly where the line SENSE (which bears no current) is connected, namely **directly at the sensor**. If this function is not used, (e.g. if fewer lines are available and the resulting temperature-dependent gain error is compensated in approximation by a scaling factor) then +**Sense must be connected to +VB** in the terminal plug.

Bridge measurement is a relative measurement (a **ratiometric process**) which evaluates the fraction of the bridge excitation voltage fed in that passes through the bridge (typically 0,1% range, corresponding to 1 mV/V). System calibration directly refers to this ratio, the bridge input range. This means that the **absolute bridge excitation voltage isn't relevant** and need not necessarily conform to the rated overall accuracy of the measurement.

To obtain the best result with the least noise possible, the bridge and the CANSAS module should be held at a shared reference voltage (ground). The ground terminal in the connection plug is designated CHASSIS.

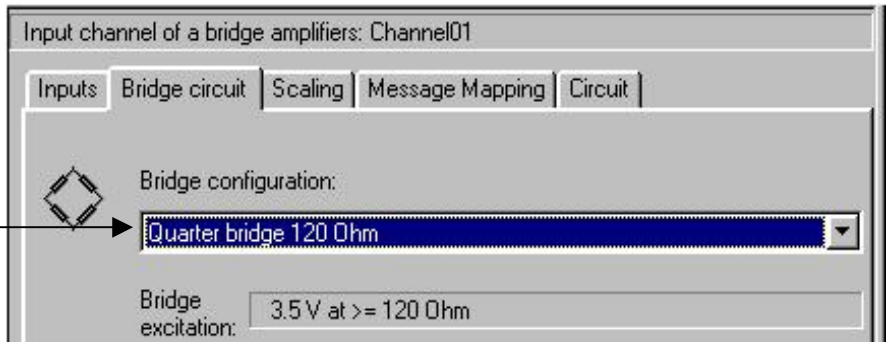
When connecting, observe the block diagram shown above and the accompanying notes.

The following bridge types can be operated as sensors by CANSAS-BRIDGE2:

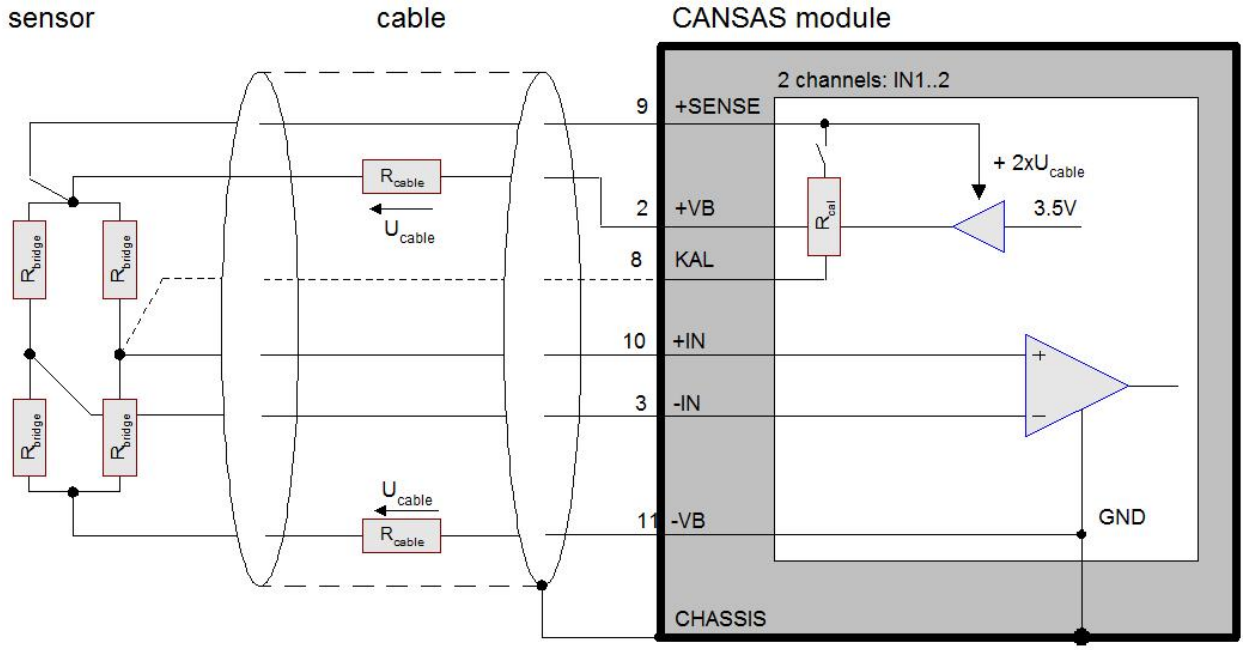
- Full bridge
- Half bridge
- Quarter bridge (120Ω)

Setting the bridge configurations:
Channel0x → Index card "Bridge circuit" → Combo box "Bridge configuration"

Depending on the operating type selected, different configurations are available as options on the "Bridge circuit" index card



6.1.2 Full bridge



Bridge2: block diagram full bridge

A full bridge connected to the CANSAS-BRIDGE2 bridge channels consists of 4 resistor arms (denoted by R_b in the block diagram). The full bridge is external, meaning that all 4 bridge resistors are outside of the CANSAS module.

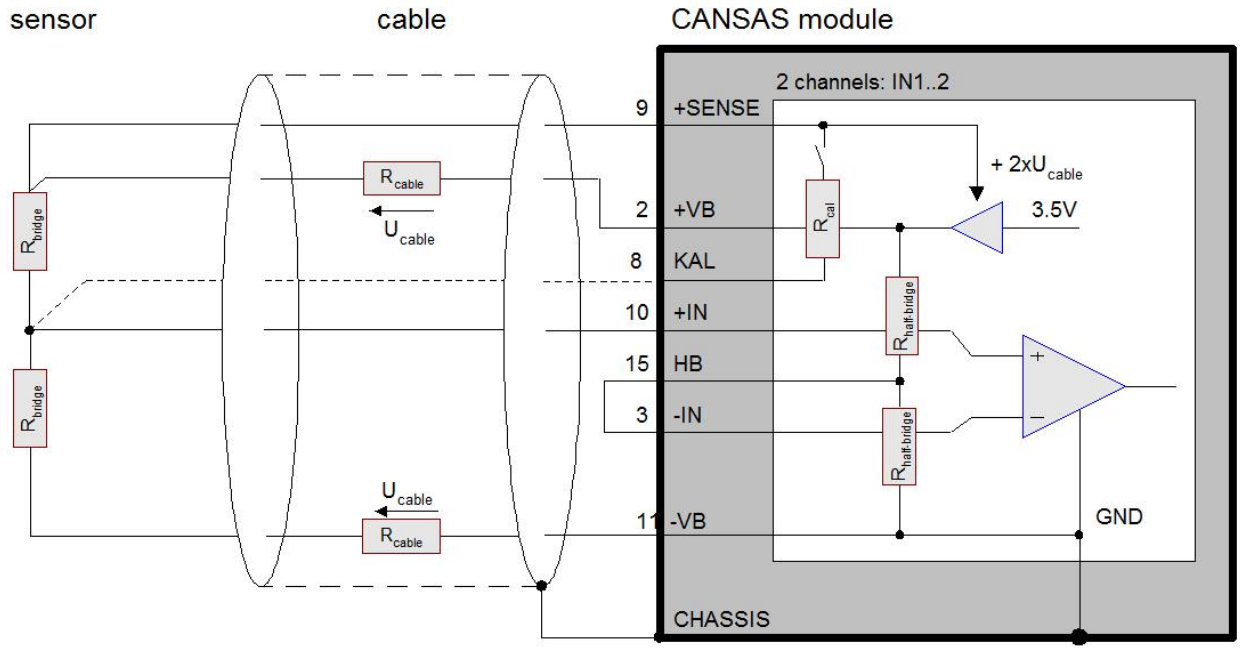
Setting the full bridge:

> *Channel0x → Index card "Inputs" → Measurement target combo box: "Sensor"*
> *Channel0x → Index card "Bridge circuit" → Configuration combo box: "Full bridge"*

The "three-wire-configuration" used in ***full bridge configuration*** to regulate the bridge voltage guarantees the required voltage values at the sensor even if the lines to it are long and highly resistant. This requires symmetric wiring (same resistance, therefore identical length and cross-section) of the current conducting signal lines, as shown in thick lines in the sketch. The bridge voltage +VB is then adjusted by the amount 2*Uk.

The internal calibration resistance can be connected to either of the two external bridge branches. In order to prevent the cable resistance, which directly affects the bridge in a ratio of (Rb / R_kal) to the bridge impedance, it should not be connected by a jumper wire but rather by a separate line.

6.1.3 Half bridge

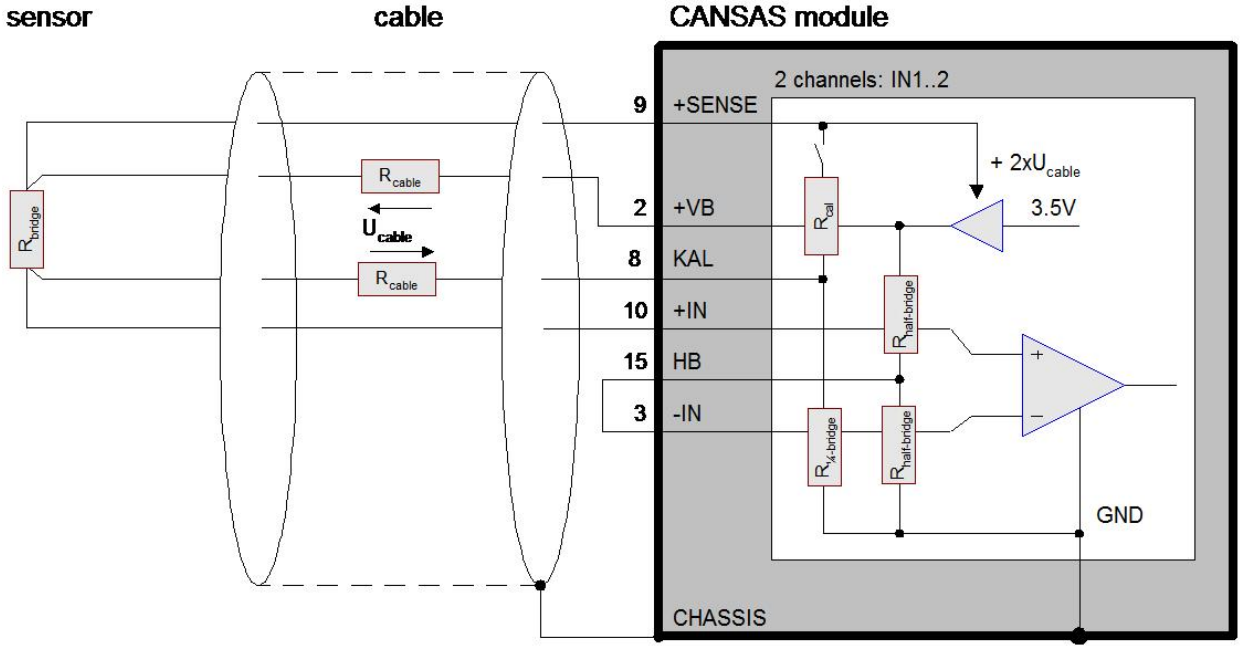


Bridge2: block diagram half bridge

In many applications, the sensor consists of only half of a full bridge, in other words of two variable impedances. The other half must then be completed with two equal resistors of constant impedance. For CANSAS-BRIDGE2 bridge channels, this half-bridge completion is **internally pre-wired**. It is accessible via the terminals of the DSUB-plug as “HB1” and “HB2” and need only be connected by a **jumper** to the corresponding input pin. Only one half bridge is external, in other words there are 2 bridge resistors outside of the CANSAS module.

Setting the half bridge:
Channel0x → Index card “Inputs” → Measurement target combo box: “Sensor”
Channel0x → Index card “Bridge circuit” → Configuration combo box: “Half bridge”

6.1.4 Quarter bridge



Bridge2: block diagram quarter bridge

If the sensor consists of only one resistor, it's possible to complete the bridge with three additional resistors. 120Ω can be selected for the external resistor with which to construct a half bridge. This resistor is switched on electronically. In order to select the resistance for the quarter bridge, “Sensor” must be selected as the measurement target and “Quarter bridge with 120Ω” must be selected as the bridge configuration. **Important note**: As with the half bridge, a jumper must be connected between “HB1” or “HB2” and the corresponding input pin in order to activate the necessary half bridge completion. This half bridge completion in turn is also internal.

Setting the quarter bridge:
Channel0x → Index card “Inputs” → Measurement target combo box: “Sensor”
Channel0x → Index card “Bridge circuit” → Configuration combo box: “Quarter bridge”

Quarter-bridge configuration, using four (symmetric) cables, enables measurement of an external ¼-bridge branch. If a gain error is considered an acceptable trade-off, it is possible to go without the "+SENSE" line, but not without separate lines for "KAL" and "+IN": Otherwise, an unacceptable offset-drift would result, since the temperature-dependent cable resistance is connected in series with to quarter bridge directly. If we assume a cable length (one-way) of 1 m, we obtain:

Cu-cable 0,14mm², 130mΩ/m, cable length l =1m	cable Rk = 130mΩ
Temperature coefficient Cu:	4000ppm / K
Drift Rk	0,52mΩ / K
Equivalent bridge drift (120Ω bridge)	½ * 0,52mΩ / (K *120Ω) = 2,2µV/V / K
Example, temperature change dT = 20K	44µV/V (dT =20K)

For the optional adjustable calibration resistance, the following applies for all three configurations: Connection to a separate line avoids an error of the shunt calibration magnitude of Rb / R_kal caused by the cable resistance to a. In quarter bridge configuration, this is inevitable, since the calibration resistor is already connected to the quarter bridge internally and even shares the pin "CAL".

Going without a separate line for "+SENSE" and direct jumpering of "+SENSE" and "+VB" at the connection terminal causes a gain error of Rk/Rb in all configurations.

6.1.5 Balancing and shunt calibration

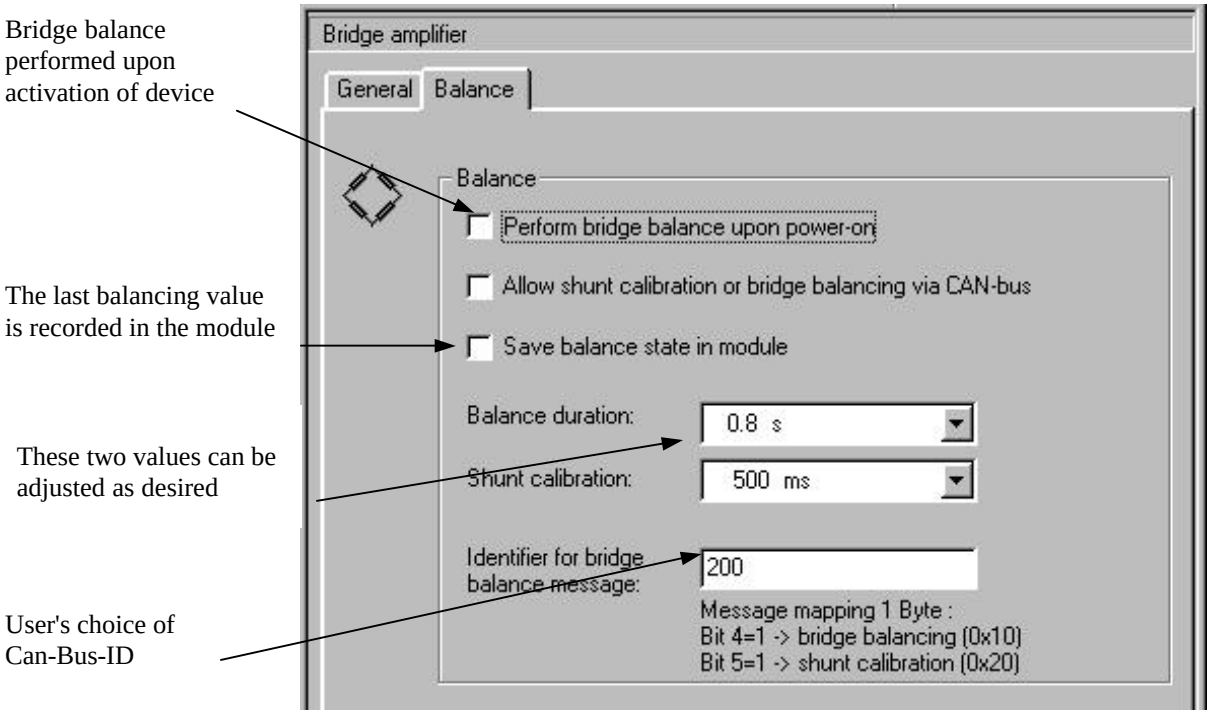
The **maximum compensable** range for each input range (3 mV/V are always assured; the table shows the values achieved in practice):

Input range	Bridge balance range
±10 mV/V	6 mV/V
±5 mV/V	3 mV/V
±2 mV/V	6 mV/V
±1 mV/V	3 mV/V
±0,5 mV/V	3,5 mV/V
±0,2 mV/V	3,8 mV/V

There are various ways to perform balancing of CANSAS-BRIDGE2:

- Pressing the special button on the CANSAS-BRIDGE2 module
- Automatic balancing upon power-up of module
- Balancing is triggered by a CAN-bus message.

All 3 options can be implemented in a configuration and can initiate balancing. However, if a balancing process is currently running, any new command to perform balancing is ignored until the current process is over. As a rule **both bridge channels are balanced at once.** If balancing isn't possible because the unbalance exceeds the balance range, this can be indicated by the LEDs on the CANSAS-BRIDGE2 module (see Chapter Measurement technique 188).


Bridge balance performed upon activation of device
The last balancing value is recorded in the module
These two values can be adjusted as desired
User's choice of Can-Bus-ID
Bridge amplifier
General
Balance
Balance
Perform bridge balance upon power-on
Allow shunt calibration or bridge balancing via CAN-bus
Save balance state in module
Balance duration:
0.8 s
Shunt calibration:
500 ms
Identifier for bridge balance message:
200
Message mapping 1 Byte :
Bit 4=1 -> bridge balancing (0x10)
Bit 5=1 -> shunt calibration (0x20)

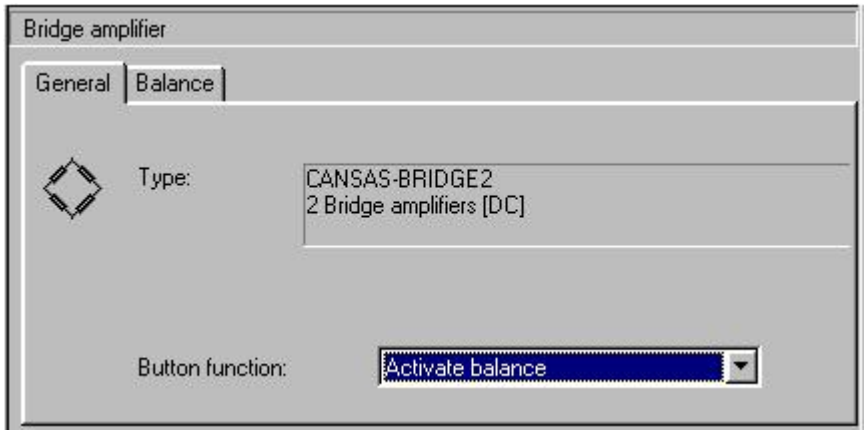
☞ **Note**

- **Note that importing a changed configuration to the module deletes any previously performed bridge balancing and resets it to zero. Therefore, always repeat bridge balancing after importing a configuration!**

6.1.5.1 Performing bridge balance by button

To have bridge balancing performed at the push of the button on the module, make the following setting:

Setting balance to be triggered by button:
Bridge amplifier → Index card "General" →
Combo box "Button ": "Activate balance"



6.1.5.2 Bridge balance upon power-up of CANSAS-BRIDGE2

If balancing is to be performed immediately upon switching on the device, make the following setting:

Setting balance to be activated upon activation of module:
Bridge amplifier → Index card "Balance" →
Mark check box "Perform bridge balance upon power up"

This mode is desirable if the system's setup (process and CANSAS module) is at rest upon switching on.

6.1.5.3 Activating bridge balance via Can-bus

Bridge balancing can be performed in response to a CAN-bus message. The message ID can be freely defined, the same conditions and properties apply as for channel messages. The message to perform balancing is 1 Byte long. Bit 4 (hexadecimal 0x10) must be "1" to order balancing. (Bit 0 is the LSB).

Setting bridge balancing via Can-bus
Bridge amplifier→ Index card "Balance" →
Check option box "Allow shunt calibration or bridge balance via CAN-bus"

Setting the message ID:
Bridge amplifier→ Index card "Balance" →
Enter ID in input box "Identifier for bridge balance message".

6.1.5.4 Bridge balance duration

CANSAS-BRIDGE2 determines a bridge's unbalance by taking readings for a certain amount of time and averaging these. The unbalance value found in this way is compensated in subsequent measurement. The duration of the balancing process, i.e. the number of values to be averaged, is variable. The duration doesn't depend on the way the balancing is triggered. The following values for the duration can be set:

Setting the balancing duration
Bridge amplifier → Index card "General" → Combo box "Balance duration"

Available times for the balance duration: 0,4 s; 0,8 s; 1,6 s

6.1.5.5 Shunt calibration

CANSAS-BRIDGE2 offers the ability to electronically shunt the measurement bridge with a **shunt calibration resistor** of approx. 100kΩ. This artificial unbalance of the bridge can provide an indication of the **measurement bridge's functioning.**

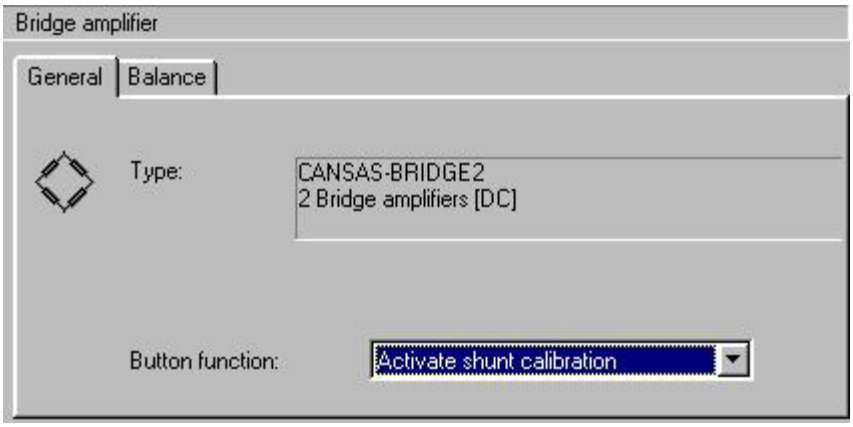
Bridge	Unbalance
120 Ω	0,30 mV/V
350 Ω	0,87 mV/V

Shunt calibration can be triggered in either of the following ways:

- By the special button on the CANSAS-BRIDGE2 module
- Via CAN-bus message

To make shunt calibration triggerable by button, make the following setting:

Setting the button to trigger shunt calibration:
Bridge amplifier → Index card "General" →
Combo box "Button function": "Activate shunt calibration"



The shunt calibration duration is discretely adjustable between 100 ms and 60s and determines how long the resistor shunts the measurement bridge. If a calibration process is currently running, any new command to perform balancing is ignored until the current process is over. The duration doesn't depend on the way the calibration is triggered.

Setting the shunt calibration duration
Bridge amplifier→ Index card "General" → Combo box "Shunt calibration"

Setting the shunt calibration to be triggered via CAN-bus is analogous to the bridge balancing. Bit 5 (hexadecimal 0x20) in the Byte triggers calibration with the value "1". (Bit 0 is the LSB).

Setting shunt calibration via Can-bus
Bridge amplifier→ Index card "Balance" →
Check option box "Allow shunt calibration or bridge balance via CAN-bus"

Setting the message ID:
Bridge amplifier→ Index card "Balance" →
Enter ID in input box "Identifier for bridge balance message.

The shunt calibration is realized in such a way that the shunt is applied for a limited time. Select a duration which is sufficient for observing the signal level. Once this time duration has elapsed, the shunt is disconnected from the circuit so that it isn't forgotten.

☞ **Note**

- If you use an imc device to measure, see application notes in chapter *Field Busses* of the *imcDevices* manual. There are examples how to use imc Devices- and CANSAS-software step by step.

6.1.6 Connector plugs BRIDGE2

For the pin assignment of the DSUB-15 plugs see here 444.

6.1.7 Sampling interval

The analog/digital converters sample the measurement signal at a fixed rate of 5 kHz per channel. A built-in **low pass filte**r (AAF, anti-aliasing filer) of **high order** and a **cutoff frequency of 1 kHz** provide suppression of frequencies in the measurement signal above the cutoff frequency which, as a result of sampling, would otherwise disturb the interesting range of the measurement signal (i.e. would cause aliasing). When slower sampling rates are selected, the signal processor (DSP) provides additional online digital filtering in order to reduce aliasing.

Note: The cutoff frequency is defined as the measurement signal's frequency component which is dampened by **3dB**.

Sampling interval	Cutoff frequency (AAF)	Filter order	Sampling interval	Cutoff frequency (AAF)	Filter order
0,2 ms	1 kHz	-	200 ms	0,83 Hz	Butterworth 3rd order
0,5 ms	333 Hz	Butterworth 3rd order	500 ms	0,33 Hz	
1 ms	167 Hz		1s	0,16 Hz	
2 ms	83,3 Hz		2s		-
5 ms	33,3 Hz		5s		-
10 ms	16,7 Hz		10s		-
20 ms	8,33 Hz		20s		-
50 ms	3,33 Hz		30s		-
100 ms	1,67 Hz		1min		-

Note that at a sampling rate of 5 kHz, the anti-aliasing filter provides strong suppression of (undesirable) signal components of half that frequency (2,5 kHz), since the cutoff frequency is already reached at 1 kHz. But if a different sampling rate is set, a digital anti-aliasing filter is applied. This software filter only provides 3rd order filtering, which is, however, perfectly adequate for most practical applications. Such filters dampen the frequency of (sampling rate ÷ 2) by around 30dB, and by more at higher frequencies, of course. 30dB is an acceptable level of damping for signal components whose strength is (in practice) only a fraction of the input range. Such minor components can be disregarded after having been dampened by 30dB. Note that the value 30dB applies to frequency components of around half the sampling rate.

6.2 CANSER-GPS

GPS to CAN converter

The CANSER module implements the GPS mouse's NMEA protocol on the CAN-Bus.
Module with GPS-mouse, CAN converter and for reception of GPS signals for the purpose of precise spatial position detection. Housing model: short. Enables synchronized acquisition of a vehicle's measurement and position data.

Technical data CANSER-GPS. 384

6.2.1 Use of CANSER-GPS

Connect the CAN-Bus to the CANSER module. If necessary, connect a CAN termination to the second CAN input. Connect the GPS mouse to one of the CANSER module's serial inputs. Finally, connect the voltage supply (9-32V) to the CANSER module.

6.2.2 LED signals of CANSER-module status:

Green flashing	Module in operation
Yellow flashing	No GPS mouse connected, contact to mouse lost.
Red flashing	CAN transfer disturbed:

- CAN-Bus either not connected or there are no other bus subscribers
- no GPS data arriving since disruption of the CAN transmission.

If one of the error conditions should arise, check the connection to the GPS mouse and to the CAN-Bus. It may be necessary to disconnect the power supply and re-connect it.

The following CAN-Bus parameter have been set:

Bus speed: 500kBaud; Identifier: Standard; IDs:2020- 2023 s

Note: Bus speed and identifier are factory-set and can not be changed by user.

Message	ID	Byte	Remark
time	2020	0-3	Long (hhmmss); Example: 1:35 PM = 133500
date	2020	4-7	Long (ddmmyy) Example= 2. Dec 2005 = 021205
longitude	2021	0-3	Real, negative numerical value indicates western hemisphere format : ddmm.mmmm (d=degree, m=minute)
latitude	2021	4-7	Real, negative numerical value indicates southern hemisphere format : ddmm.mmmm
speed	2022	0-3	Real, unit knots
direction; course over ground	2022	4-7	Real, direction in degrees
mean height above sea level	2023	0-3	Real, mean antenna elevation above NN
number of satellites	2023	4-5	Integer; number of satellites used
state	2023	6-7	1: valid ; 0 invalid

The CANSER module has a permanently configured Baud rate of 4800 bit/s. If the 5 Hz GPS mouse (Garmin GPS 18 5 Hz) is to be used instead of the default 1 Hz GPS-mouse, then this 5 Hz GPS-mouse

must be set to this Baud rate using Garmin's configuration program (SNSRCFG.exe). The CANSER module then receives the 5 Hz GPS-mouse's data, although not with full 5 Hz resolution.

☞ **IMPORTANT NOTE**

If you use the GPS mouse with an imc CRONOS-PL/SL unit, observe the following:

CRONOS-PL/SL communicates with the connected GPS receiver at a Baud rate of 19,200 Bit/s. When the GPS mouse is connected, CRONOS-PL queries the Baud rate and modifies it if necessary. **If you subsequently run the GPS mouse with the CANSER, the Baud rate must first be reset to 4800 Bit/s using Garmin's configuration program (SNSRCFG.exe).**

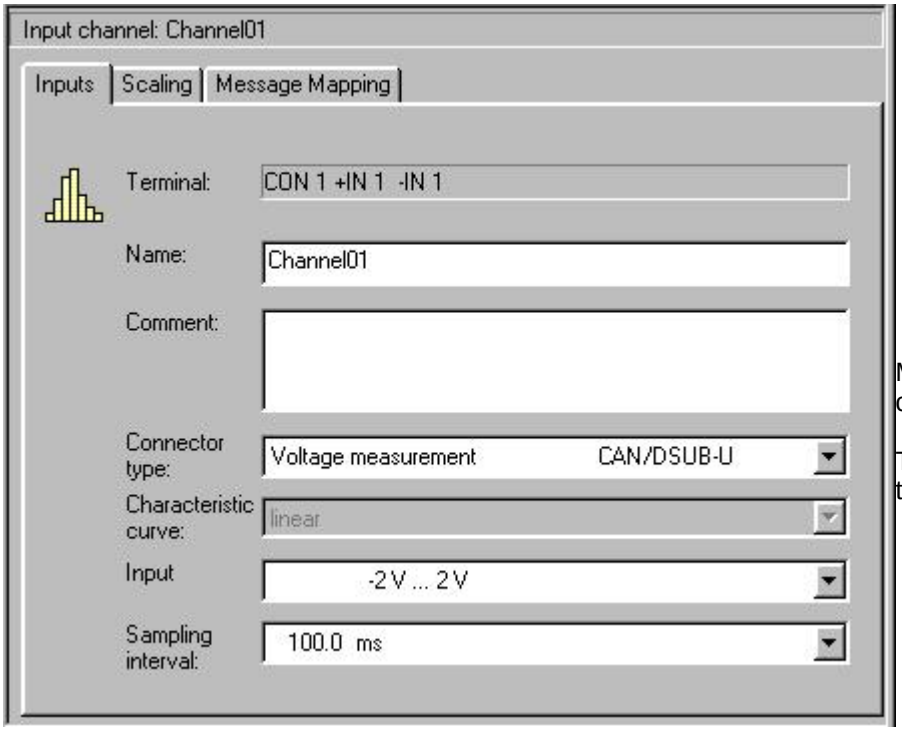
6.3 C12 voltage, temperature, current

12 analog inputs

Parameter	Value (typ. / max)	Remarks
Inputs	12	6 channels on each DSUB-15 socket
Measurement modes	voltage voltage with divider current thermocouples Pt100	configurable in blocks of 6 (CAN/DSUB-U6)standard-plug (CAN/DSUB-U6D)divider-plug (CAN/DSUB-I6)shunt-plug (CAN/DSUB-T6)thermo-plug (CAN/DSUB-PT)PT100-plug: 4 channels with contacts for 4-wire connection or voltage plug (CAN/DSUB-U) 6 channels without contacts for 4-wire connection.

Technical data C12. 385

The CANSAS C12 module has 12 input channels. Signals for voltage, current, any DINconforming thermocouples or PT 100 units can be connected. Different screw-terminal plugs are provided for the respective types of measurements; use the appropriate terminal and select it on the input channel's 'Input' dialog under the heading 'Connector type'. It is crucial that the terminal type actually connected matches the entry in the ***'Connector type'*** box.



Make sure the screw terminal connected matches this setting

The appropriate screw terminal type is indicated in the list box.

In this module the input channels are organized in two groups of 6 channels. All channels within a group must have the same setting under 'Instrument'. Group 1 comprises Channels 1 through 6, Group 2

Channels 7 through 12.

Voltage and current measurements' signals conform to linear characteristics. Temperature measurements, by contrast, need to be prepared by specifying the thermocouple used in the combo-box 'Characteristic curve'. The module can work with no more than one temperature characteristic curve; it's not possible to measure with a thermocouple of type R in Socket 1 and with a thermocouple of type E in Socket 2. The same constraint applies to PT100's.

In the combo-box **Input range**, input ranges for linear measurements can be specified. The following range options are available:

Voltage measurement	Voltage measurement (extended)	Current measurement
± 2V	The plug must not be connected to voltages over 40 V.	±40 mA
± 500 mV	±50V	±10 mA
±100 mV	±10V	±2 mA

The input ranges as shown in the table are valid if the user-specific scaling factor is 1 and the user-specific scaling offset is 0. Both scaling quantities are set on the 'Scaling' index card. The input range displayed takes both of these quantities into account.

$$Upper\_input\_range\_Limit = \frac{2V * user\_specific\_scaling\_factor}{gain\_factor} * user\_specific\_offset$$

$$Lower\_input\_range\_Limit = \frac{-2V * user\_specific\_scaling\_factor}{gain\_factor} * user\_specific\_offset$$

If the user-specific scaling factor is not calculable (division by zero), the input range is not indicated or simply cannot be set. As soon as a different connector type is selected in the corresponding dialog control, the scaling values return to their default values and the input range once again can be selected.

Each module group can only be set to a joint gain factor, in other words, can only work with a joint input range. The program guarantees this set-up by automatically adapting all channels to any changes made to the input range of one of their group's channels.

If temperature measurement is the connector type set in the dialog, the thermocouple desired can be selected in the combo-box 'Characteristic curve'. The thermocouples are listed in .imc Thermo-plug 450

The input range indicator can be toggled between display in °C and °F.

When measuring with a **Pt 100** unit, the input range can only be toggled between the two settings °C and °F, and measurements cannot be conducted over the input channels 5, 6, 11 and 12.

The sampling rates can be set individually for each channel.

2 ms	100 ms	2 s	30 s	**Note:** Regardless of the sampling rate set, the channels are sampled at 2 ms. The values accruing during the sampling interval are subsequently averaged.
10 ms	200 ms	5 s	1 min	
20 ms	500 ms	10 s		
50 ms	1 s	20 s		

With ***CANSAS-C12*** (with or without divider plugs), the reference potential discrepancies (-IN) between different sensors can be no greater than ±40 V without causing damage. Up to a discrepancy of ±5 V, there is no loss of system precision (but typically not even up to ±40V).

When measuring relatively large voltages with the divider-plugs, it may be necessary to note the polarity of the "differential inputs"!

+40 V differential voltages can result by combining respective absolute potentials of
-IN***1*** = +20 V and IN***2*** = 20 V in relation to an arbitrary reference potential (e.g. "GRND").

This means:
If a range of ***±20 V (or, respectively, ±2,5 V) referring to a common (though "arbitrary") reference point*** is ensured for every measurement input, this conforms to allowable limits. Measurement with PT100-units represents a special case:

> All of a plug's connected PT100 sensors are fed by a common reference current supply, so that there is no potential isolation between the individual channels.
>
> The cancellation of the potential isolation even affects ***both input plugs***:
> The PT100-channels of the one plug (Plug1) cyclically assume the potential of the channels at Plug 2!
> Also, the entire cabling for the PT100 channels amounts to a dynamic capacitive load at Plug 2's inputs.
>
> For this reason, ***mixed operation*** consisting of PT100-measurements on one plug and current/ voltage measurement on the other is not advised.

Voltages in ranges >2 V are connected at the so-called Divider plug (CAN/DSUB-U6D).

For current measurements, a plug with shunt resistors is available (CAN/DSUB-I6).

For temperature measurement, the special Thermo-plug (CAN/DSUB-T6) is available. It comes with built-in cold junction compensation.

A specially PT100 plug is also available (CAN/DSUB-PT100), which enables the direct connection of PT100 resistors in 4-wire configuration and which comes with a built-in reference circuit.

6.3.1 Connector plugs C12

For the pin assignment of the DSUB-15 plugs see here 445.

6.4 C8 voltage, temperature, current

8 differential, analog inputs

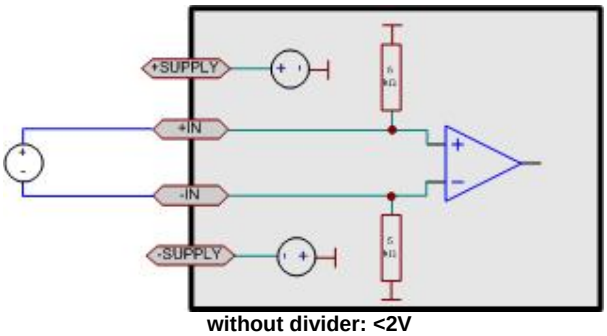
Variety	Properties	Remarks
Standard (DSUB)	- voltage measurement 60 V…5 mV - temperature measurement with thermocouples - temperature measurement with PT100-resistors -current measurement with shunt connector (ACC/ DSUB-I4)	CANSAS-C8 CANSAS-L-C8- SUPPLY CANSAS-K-C8 CANSAS-K-C8-SUPPLY CANSAS-SL-C8-D CANSAS-SL-C8-D-SUPPLY
LEMO	- voltage measurement 60 V…5 mV - temperature measurement with PT100-resistors -current measurement	CANSAS-SL-C8-L CANSAS-SL-C8-L-SUPPLY
BNC	- voltage measurement over BNC sockets 60 V…5 mV	CANSAS-K-C8-BNC
2T	- temperature measurement with thermocouples over 2 pin TK sockets as per IEC 584	CANSAS-K-C8-2T
special		
Var. I with round plug 5-pin Fischer	- voltage measurement 60 V…5 mV - supply voltage for external sensors 24 V...2,5 V; ±15 V	
Var. II with round plug SOURIAU	- temperature measurement with thermocouples	

Technical data C8, 387

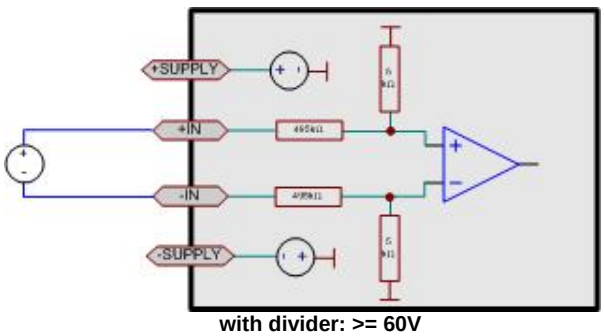
6.4.1 Voltage measurement

- ±60 V... ±2 V with divider
- ±1 V... ±5 mV without divider

A voltage divider is in effect in the voltage ranges ±6 0 V to ±2V; the resulting input impedance is 1 MΩ - even when the device is deactivated. The input configuration is differential and DC-coupled.



without divider: <2V



with divider: >= 60V

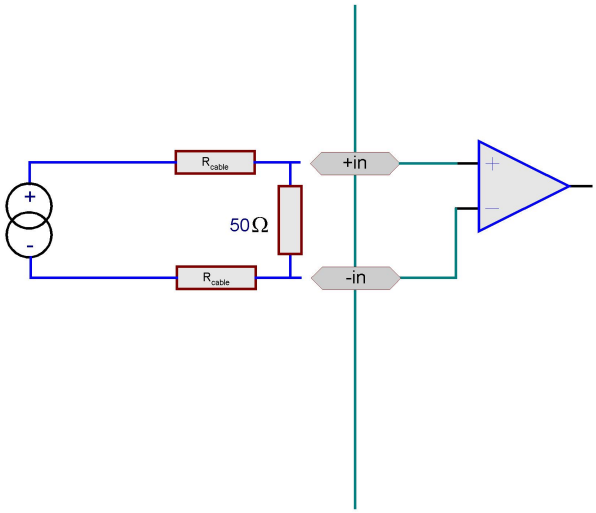
The voltage source itself already has a connection to the CANSAS-module's ground. The potential difference between the voltage source and the CANSAS ground must be fixed.

The standard DSUB is called *ACC/DSUB-U4*.

Example: The CANSAS-module is grounded. Thus, the input D is also at ground potential. If the voltage source itself is also grounded, it's referenced to the CANSAS ground. It doesn't matter if the ground potential at the voltage source is slightly different from that of the device itself. But the maximum allowed common mode voltage must not be exceeded.

If the voltage source has no ground reference: The voltage source's potential floats freely in relation to CANSAS ground. In such a case, a reference to ground must be set up. One way to do this is to ground the voltage source itself. It is also possible to connect the negative signal input to CANSAS' ground, in other words, connect "-in" and GND. You must make certain that the signal source's potential really can be adjusted to the potential of CANSAS ground without causing a significant current to flow. If the source can't be adjusted (because it is fixed), the CANSAS unit is in danger of sustaining permanent damage.

6.4.2 Current measurement

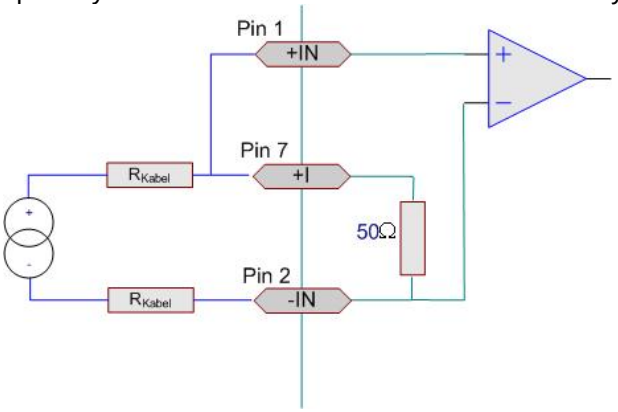


- ±40 mA ... ±2 mA

For current measurement, a **shunt** is built into the imc current connector (ACC/DSUB-I4).

The terminal “(GND)” may not be connected, and particularly not grounded!

With the housing model SL with LEMO connectors, current measurement is connected via an internal 50Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN. For current measurement, the pins +I and +IN must be shorted. This connection may only be made for current measurement purposes, and must be cleared for all other measurement types. For this reason imc offers a cable specially constructed with this connection exclusively for current measurement.



6.4.3 Temperature measurement

The C8-module's channels are designed for measurement with **thermocouples and PT100**-sensors (RTD, platinum resistance thermometer as per DIN and IEC 751). Any combination of sensor types can be connected. All common thermocouple types with their characteristic curves are supported. However, it is only possible to measure with multiple thermocouples at the same time if they are all of the same type. Thus, two Type K channels will work, but not 1 channel Type K and one channel Type B won't. A combination of thermocouple measurement and Pt100 measurement, by contrast, is possible.

The terminal point compensation for the thermocouple measurements is either built-in or is handled by the imc-Thermoplug, depending on the device variety.

6.4.3.1 imc thermoplug (type: Standard DSUB)

The patented imc-Thermoplug(*ACC/DSUB-T4*), which is a pod containing a DSUB-15 screw terminal and a built-in temperature sensor (PT100), provides ***cold junction compensation***. This enables any type of thermocouple to be directly connected to the differential inputs (+*IN* and -*IN*) without the need for a compensation line:

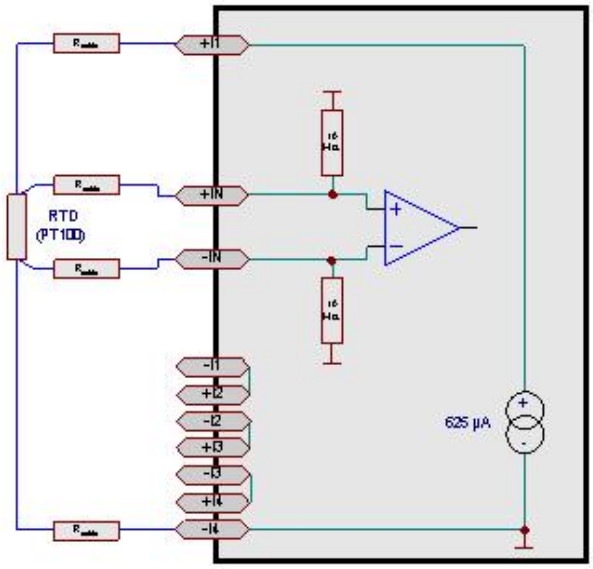
A sensor measures the temperature at the connection terminal and correspondingly compensates the thermoelectric voltage. Normally, a special compensation line or plug made of the same material as the particular thermocouple type must be used to connect the terminal to the cold junction (reference point) in the device interior, in order to prevent the formation of additional (uncontrolled) parasitic thermocouples.

The imc system avoids this problem by means of individual compensation sensors directly inside the connector pod and thus provides a convenient, flexible and affordable interconnections solution.

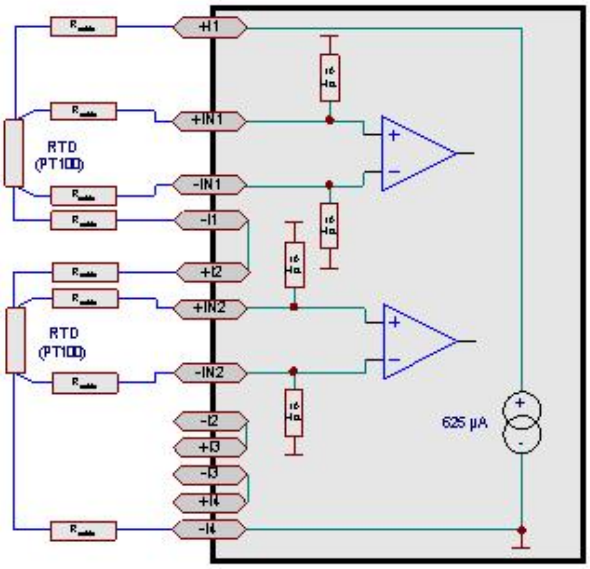
6.4.3.2 Measurement with PT100 (RTD) (Type: Standard DSUB)

Besides thermocouples, it's also possible to connect ***PT100 sensors*** directly in ***4-wire-***configuration. A (supplementary) reference current source feeds up to four sensors connected in series jointly.

When the imc-Thermoplug is used, the connection terminals are already wired in such a way that this reference circuit is "automatically" closed.



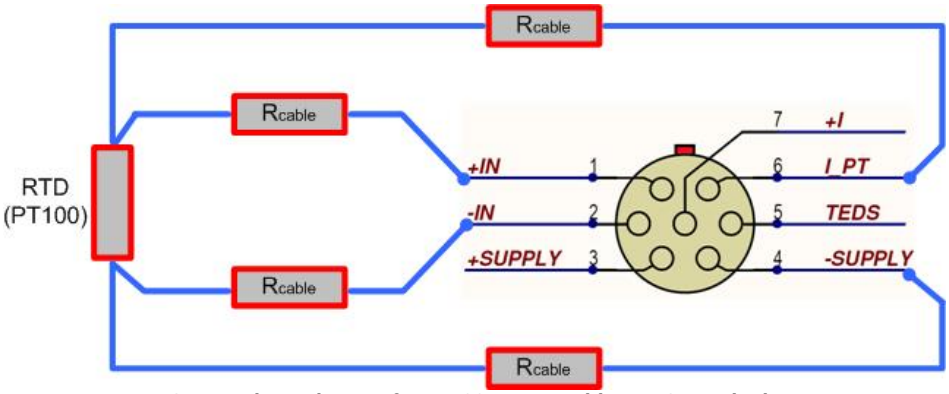
Example for one PT100 in 4-wire configuration



Example for two PT100 in 4-wire configuration

6.4.3.3 Measurement with PT100 (RTD) (Type: LEMO)

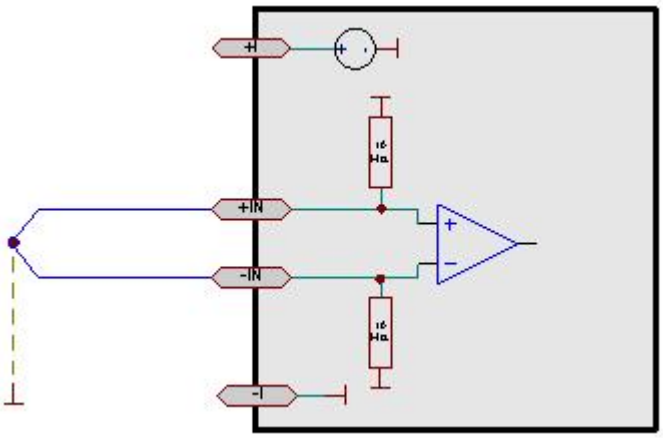
With the LEMO terminals at the IP65 housing SL it's only possible to connect ***PT100 sensors*** directly in ***4-wire-configuration***. A (supplementary) reference current source feeds the sensor. How to connect a PT100 sensor is shown below.



Connection scheme of a PT100 sensor with LEMO terminals

6.4.3.4 Thermocouple measurement (Type II: round plugs)

The cold junction required for the operation of thermocouples is located within the connector pod and its temperature is measured and accounted for by the measurement device.



Thermocouple (isolated and referenced to external potential by means of spot-welded contact)

The thermocouple is mounted in such a way that it already is in electrical contact with the CANSAS module's ground/ chassis. The thermocouple is connected for differential measurement.

The thermocouple itself already is referenced to the CANSAS-module's ground. This is ensured by attaching the thermocouple to a grounded metal body, for instance. Since the C8 unit is grounded itself, the necessary ground reference exists.

It is not a problem if the ground potential at the thermocouple differs from that of the CANSAS units by a few volts. However, the maximum allowed common mode voltage may not be exceeded.

6.4.4 Module Sensor SUPPLY

The DSUB-15 connectors each provide a terminal for an optional **supply voltage** (±2%) for external sensors.

When selecting a positive (unipolar) voltage supply (e.g. 5V), it is gripped between *+Vs* and *GND.* When using a bipolar voltage supply *(*±15V*), +Vs* and *–Vs* must be connected to the sensor supply*, GND* is in between then, which is 0V. For the CANSAS-SL-C8-L-SUPPLY there is only an unipolar voltage supply available.

Without supply module, there is no voltage provided for connected sensors.

The supply voltage can only be set at one common setting which applies to all measurement inputs.

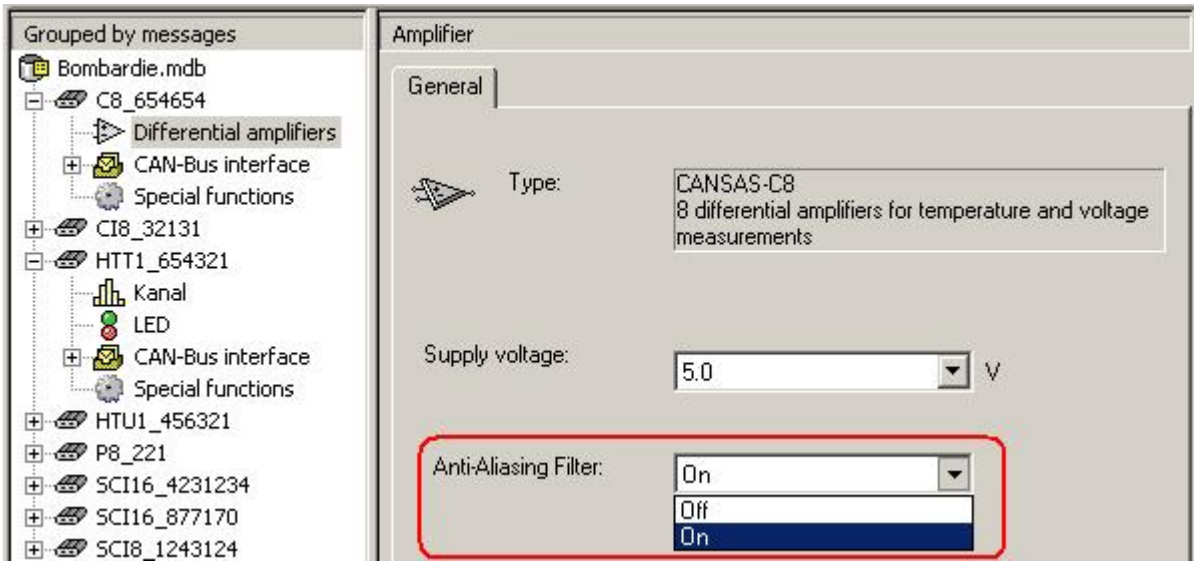
Important!

Before a sensor will be connected, make sure the voltage supply has been set correctly (not too high). Therefore the voltage supply must be set and configured using the software. Then the sensor can be connected. Otherwise the sensor and the CANSAS-module could be damaged.

The technical specification of the SUPPLY 427.

6.4.5 Sampling intervals, filters and anti-aliasing

For each of the 8 channels, the sampling interval can be freely set to between 10 ms an 60s. C8 comes with a hardware-based, permanent anti-aliasing filter, an analog-digital-converter (ADC) using the sigma-delta method, and finally a digital low-pass filter adapted to the sampling rate.



On: Additional digital low-pass filter.

Off: Switch off the digital low-pass filter. The analog anti-aliasing filter takes always effect.

The table below shows which resulting filter is used.

For temperature measurement (Pt100 and thermocouples):

Sampling rate	Filter
10 ms	Critical damping, 4th order, cutoff frequency 12 Hz
20 ms	Critical damping, 4th order, cutoff frequency 6 Hz
50 ms	Critical damping, 4th order, cutoff frequency 2 Hz
100 ms	Critical damping, 4th order, cutoff frequency 1 Hz
200 ms	Critical damping, 4th order, cutoff frequency 0,5 Hz
500 ms	Critical damping, 4th order, cutoff frequency 0,2 Hz
1s	Critical damping, 4th order, cutoff frequency 0,1 Hz
2s ..60s	Arithmet. mean over the duration of the sampling interval of values sampled at 100 Hz

All other measurement types (voltage, current and resistance):

Sampling rate	Filter
10 ms	Butterworth, 2nd order, cutoff frequency 20 Hz
20 ms	Butterworth, 2nd order, cutoff frequency 10 Hz
50 ms	Butterworth, 2nd order, cutoff frequency 4 Hz
100 ms	Butterworth, 2nd order, cutoff frequency 2 Hz
200 ms	Butterworth, 2nd order, cutoff frequency 1 Hz
500 ms	Butterworth, 2nd order, cutoff frequency 0,4 Hz
1s	Butterworth, 2nd order, cutoff frequency 0,2 Hz
2s ..60s	Arithmet. mean over the duration of the sampling interval of values sampled at 100 Hz

The filters are optimized to provide good suppression of interference while causing only insubstantial signal surges in the time domain and only minor delay times. Note that the filters selected are not perfect anti-aliasing filters (e.g. with damping of 96dB at one-half of the sampling frequency).

If you use a sampling interval other than 1 ms and the default filter is not suited to your measurement requirements, simply select 1 ms as the sampling interval and then arrange the appropriate low-pass filtering or averaging by means of a virtual channel.

6.4.6 Connector plugs C8

6.4.6.1 Standard variety (DSUB-15)

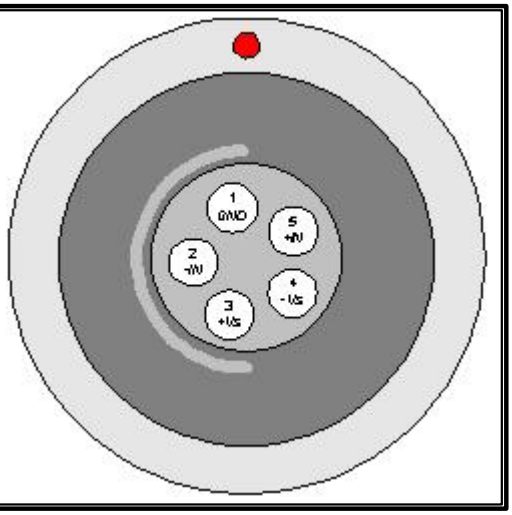
For the pin assignment of the DSUB-15 plugs see here 445.

6.4.6.2 Variety I (5-pin Fischer round plugs)

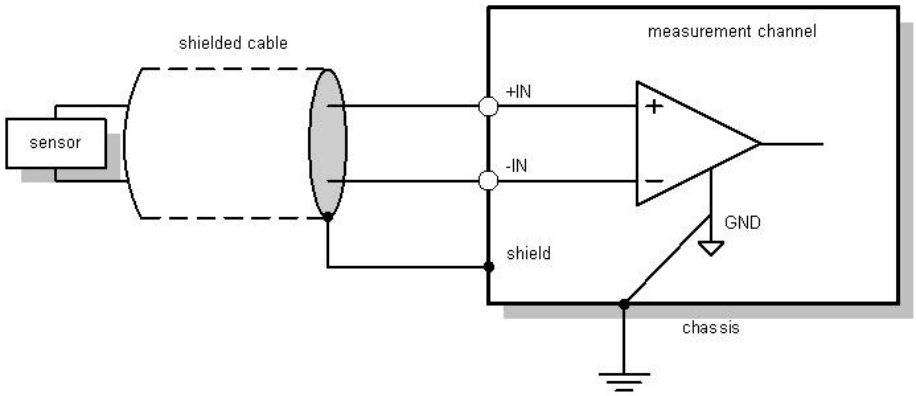
The eight measurement inputs connected by the round plugs IN1 through IN8 are for voltage measurement only. They are **differential** and **not mutually isolated**.

The device comes with a voltage supply unit for the supply of sensors.

Pin configuration of round plug:

Terminal (pin number)	**Signal**	
1	measurement ground (*GND*)	
2	neg. measurement input (*-IN*)	
3	positive sensor supply (+V_s)	
4	negative sensor supply (-V_s)	
5	pos. measurement input (*+IN*)	

The measurement inputs should be connected using a shielded cable in which both the positive and neg. measurement inputs (*+IN* and *-IN*) are located inside the shielding. the shielding must be connected to the terminal pod housing.



6.4.6.3 SL Variety LEMO

see pin configuration of LEMO terminals 455.

6.5 CI8 isolated voltage channels with current and temperature mode

8 differential, analog inputs

Parameter	Value (typ. / max.)	Remarks
Inputs	8	2 x DSUB-15 / 4 channels
Measurement modes (DSUB)	voltage temperature, RTD (Pt100) current resistor	with shunt connector (ACC/DSUB-I4)
Measurement modes (LEMO and ITT Veam)	voltage current RTD (Pt100) resistance	with internal shunt
Measurement mode (2T)	temperature type-K	

Each of the module CI8's isolated voltage channels has its **own isolated amplifier**, operated in the voltage mode. Along with **voltage** measurement, **current** measurement (with DSUB via a shunt plug), **resistor** and **temperature** measurement are all provided for.

The CI8 module supports **TEDS** to read and write sensor information.

Beside working with CAN-bus per default, the CI8 is also configurable as **CANopen**® module.

The **analog bandwidth** (without low-pass filtering) of the isolated voltage channels is 440 Hz(-3dB).

Technical data CI8. 389

General remarks on isolated channels:
When using an isolated channel (with or without supply), one should make sure the common mode potential is "defined", one way or another: Using an isolated channel on an isolated signal source usually does not make sense. The very high common mode input impedance of this isolated configuration (> 1GΩ) will easily pick up enormous common mode noise as well as possibly letting the common mode potential drift to high DC-level. These high levels of common-mode noise will not be completely rejected by the amplifier's common-mode (isolation-mode) rejection.

So, as a general rule: isolated amps should be used in environments where the common-mode level is high but "well defined" in terms of a low (DC-) impedance towards (non-isolated) system ground (CHASSIS).

In other words: isolated amps are used in environments where the common mode levels and noise are already inherent in the process and not just accidental results of the equipment's isolation.

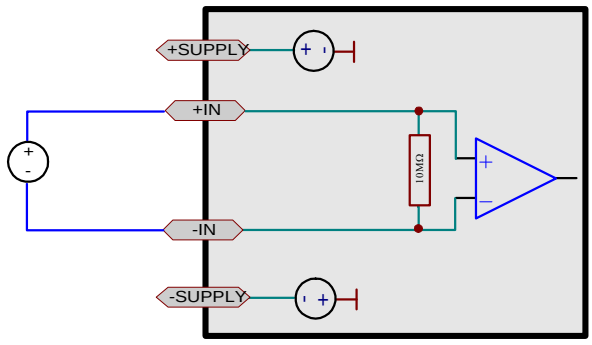
If, in turn, the signal source itself is isolated, it can be forced to a common-mode potential, which is the potential of the measurement equipment. This is the case with a microphone: the non-isolated power supply will force the common mode potential of the microphone and amp-input to system ground instead of leaving it floating, which would make it susceptible to all kinds of noise and disturbance.

6.5.1 Voltage measurement

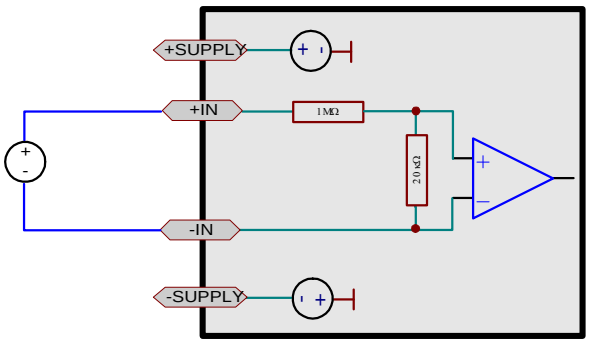
- Voltage: ±60 V ... ±5 V with divider
- Voltage: ±2 V ... ±50 mV without divider

An **internal pre-divider** is in effect in the voltage ranges ±50 V to ±5 V. In this case, the differential input impedance is 1 MΩ, in all other ranges 1 MΩ. If the device is de-activated, the impedance is always 1 MΩ.

The inputs are DC-coupled. The differential response is achieved by means of the isolated circuiting.



configuration for voltages < 5V



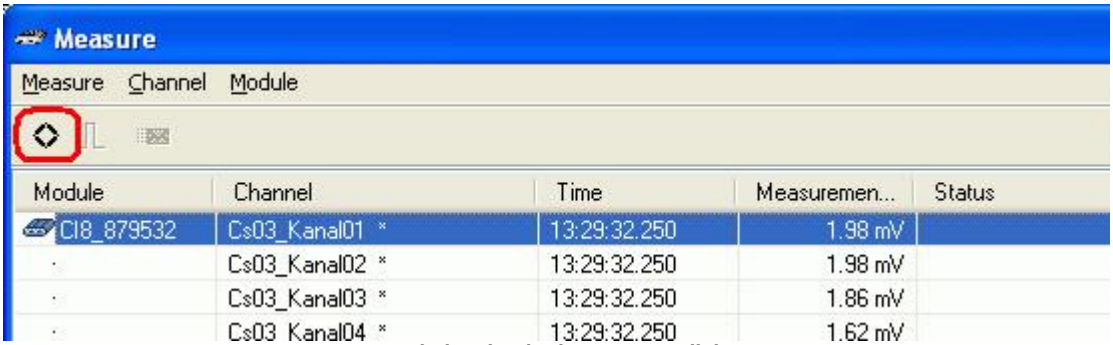
configuration for voltages > 2V with internal divider

6.5.1.1 Voltage measurement with zero balancing

In the measurement mode *voltage measurement with zero balancing*, it is possible to balance the measured value.

This is accomplished for all selected channels either by means of the channel menu command Balance in the measurement window or on the Balance page accessed via the module node Isolated amplifier.

Balancing using the Measure dialog


Measure
Measure Channel Module
Module Channel Time Measuremen... Status
CI8_879532 Cs03_Kanal01 * 13:29:32.250 1.98 mV
Cs03_Kanal02 * 13:29:32.250 1.98 mV
Cs03_Kanal03 * 13:29:32.250 1.86 mV
Cs03_Kanal04 * 13:29:32.250 1.62 mV

Zero balancing in the Measure dialog

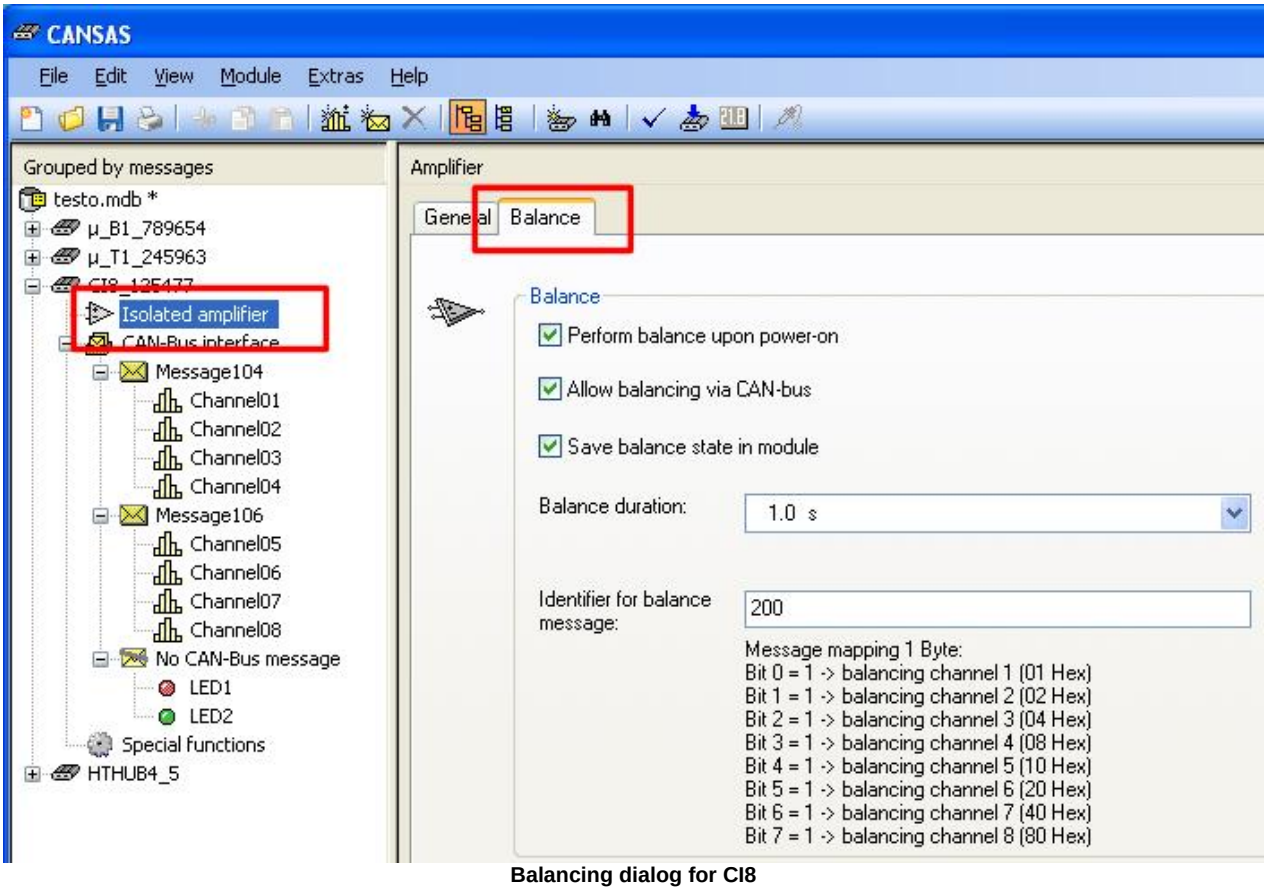
Input range [V]	Compensable initial offset* [V]		Input range [V]	Compensable initial offset* [V]
±50	0,3		±0,5	0,09
±20	10		±0,2	0,09
±10	5		±0,1	0,19
±5	10		±0,05	0,24
±2	0,35		±0,02	0,27
±1	0,19			

In the Measure window, balancing is performed by selecting one or more channels and clicking on the Balance button.

Balancing using the Balance dialog

This dialog is available under the CI8's node *Isolated amplifier*. It enables automatic balancing each time the device is activated. You can also store the balancing values in the module permanently, so that they are

not lost as soon as the device is deactivated. It is also possible to perform a balancing procedure at a specific point in time as desired.



Balancing dialog for CI8

Perform balance upon power-on:

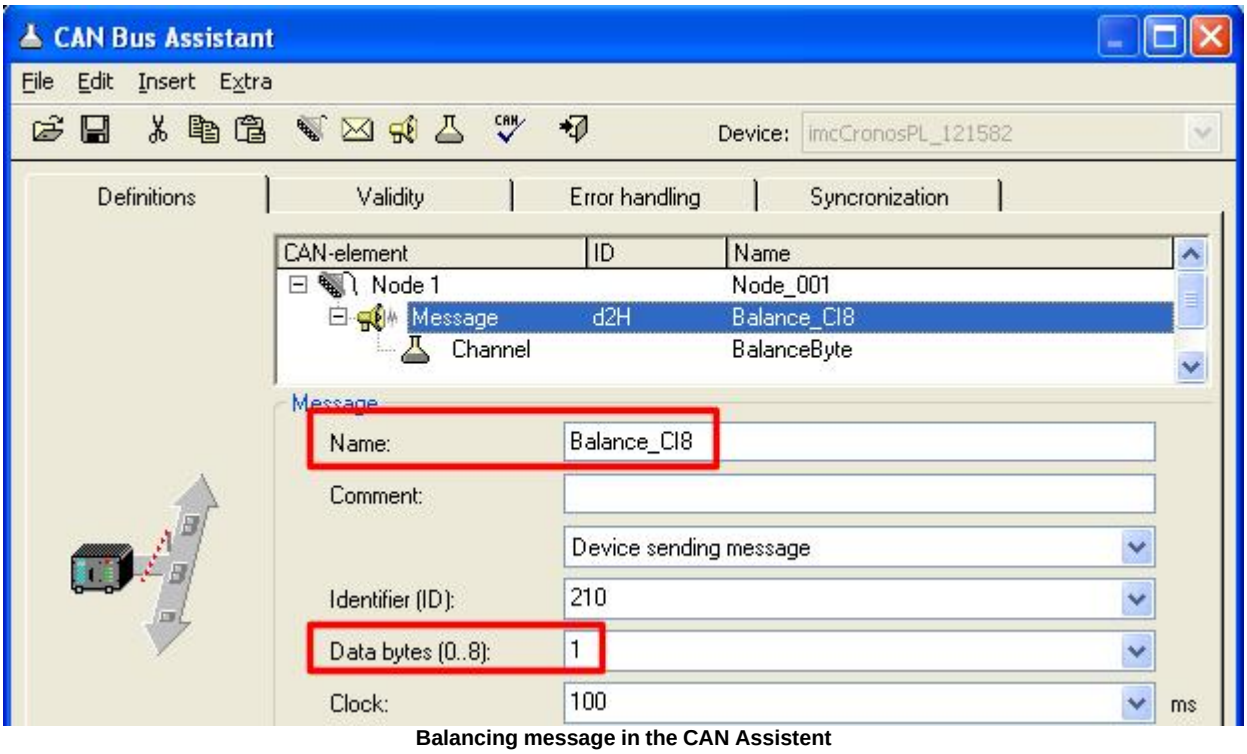
Each time it is activated, balancing of the module is carried out. However, this setting should only be used if it can be ensured that the sensors used are in rest state upon every activation. Otherwise there is a danger that a valid balancing will be written over due to a brief deactivation.

Allow balancing via CAN-Bus:

This optional setting enables the module to be balanced at selected times. Towards this end, a CAN-message containing one data byte is sent to the module, whose value is 0x01Hex. It is helpful to combine this process with the next option *Save balance state in module*, since in that case the balancing value remains intact even after deactivation.

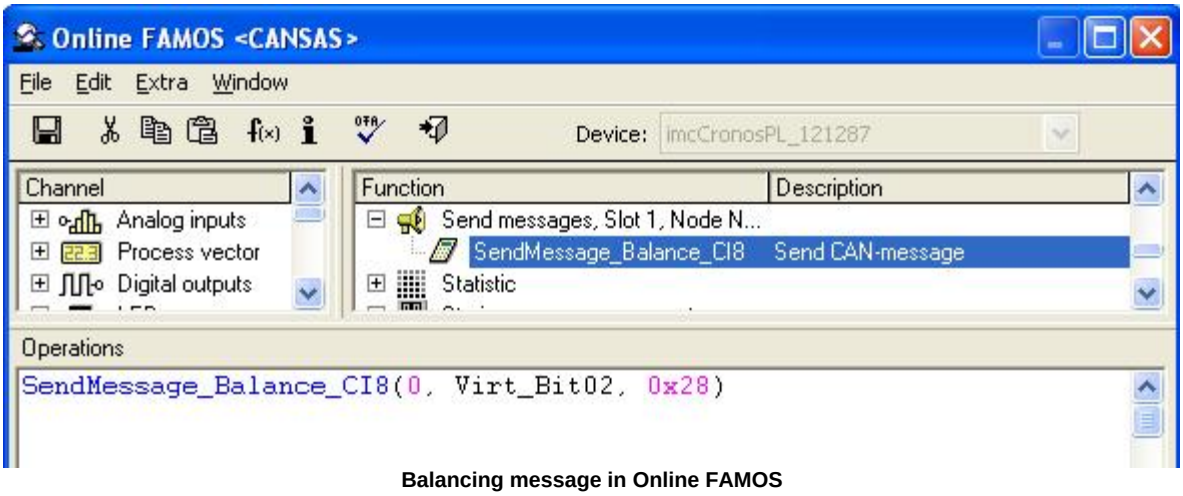
Example: Identifier for balance message = 210, channels 3 and 5 are to be balanced.

1. Creating the Send-message in the CAN-Assistant: A message with one data byte is required. Assign a distinct name to this message. Next assign this message to a channel. Since only one data byte is available, the length of this channel can have a maximum of 8 bits. All other settings do not play any role here.



Balancing message in the CAN Assistent

2. Online FAMOS (imcDevices) sends a message if the virtual bit Bit02 is set. In the data byte, the value 28Hex is transmitted, which consists of the values for channel 3= 0x08H plus channel 5= 0x20H.



Balancing message in Online FAMOS

Save balance state in module:

This optional setting ensures that the balancing values are not lost once the device is deactivated.

Balance duration:

Data acquisition for determining the averaged balancing value. If the input signal fluctuates somewhat around the rest state, a longer duration can cancel out these fluctuations.

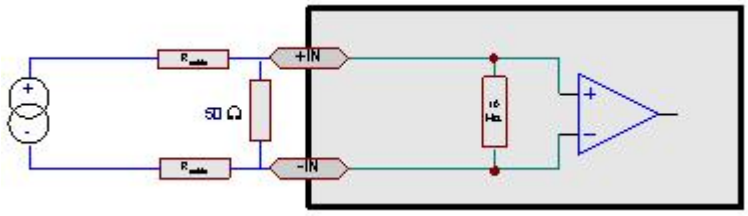
Identifier:

A message to perform balancing must bear the identifier set here.

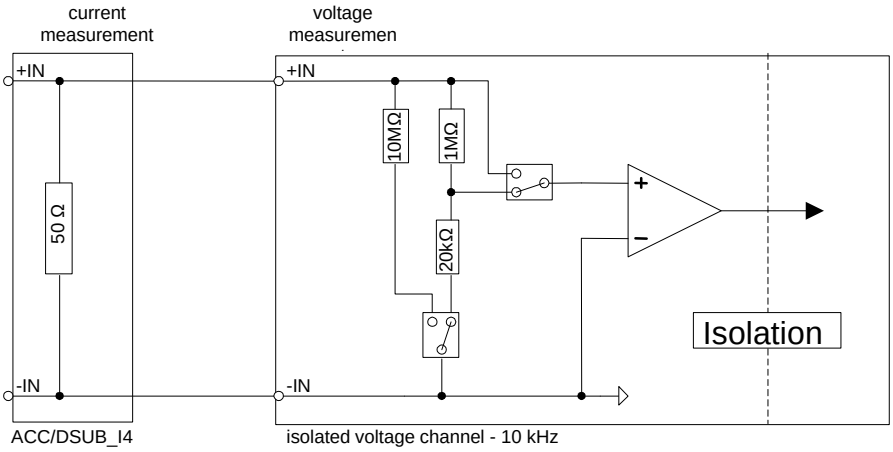
6.5.2 Current measurement

- Current: ±20 mA, ±10 mA in 2 ranges

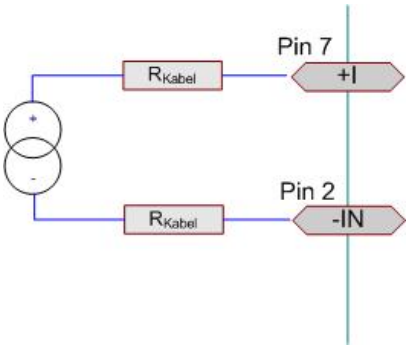
A special plug (order-code: ACC/DSUB-I4) with a built-in **shunt (50 Ω)** is needed for current measurement. Configuration is performed in voltage mode, whereby an appropriate scaling factor is entered in order for amperage values to be displayed (20 mA/V = 1/50Ω).



Input stage block schematic

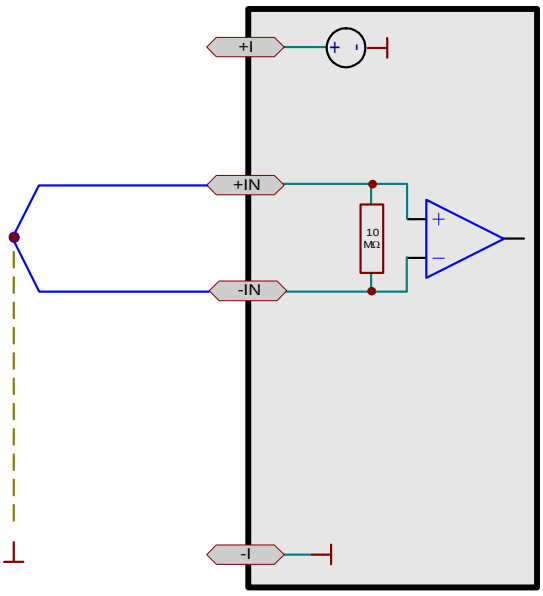


At the CANSAS-SL-CI8-L(-SUPPLY) with LEMO connectors, current measurement is connected via an internal 50Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN.

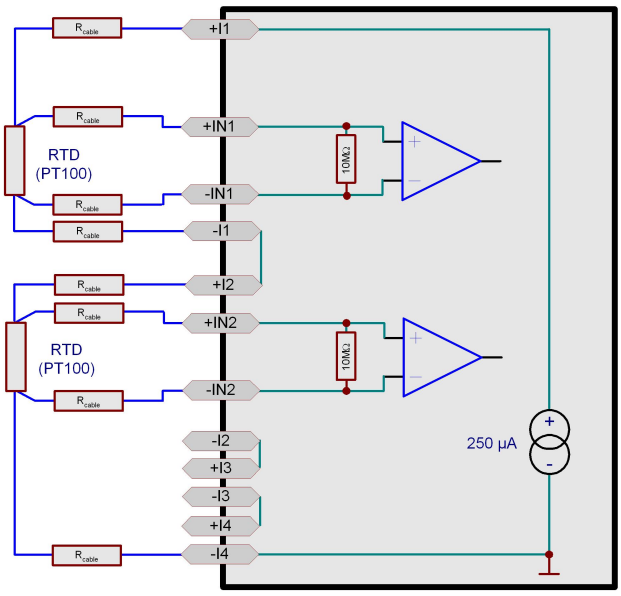


6.5.3 Temperature measurement

The CI8 temperature channels are designed for direct connection of ***thermocouples and PT100***-sensors (RTD, platinum-resistance thermometers). ***Any combination*** of both sensor types can be used; all common thermocouple types are supported along with their particular characteristic curves.



configuration for thermocouples



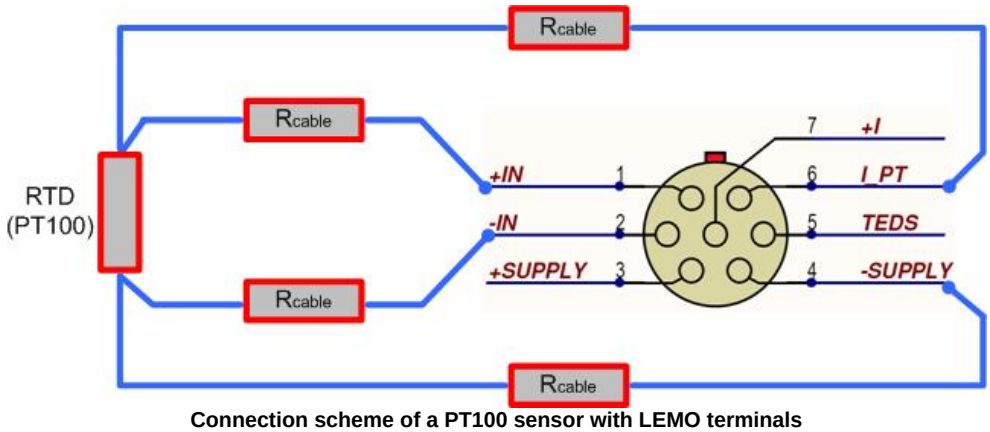
configuration for two PT100 (RTD)

Note

The mode for thermocouples is also available for CI8-LEMOSA. Please note, that the cold junction compensation must be completed externally (e.g. with ice water).

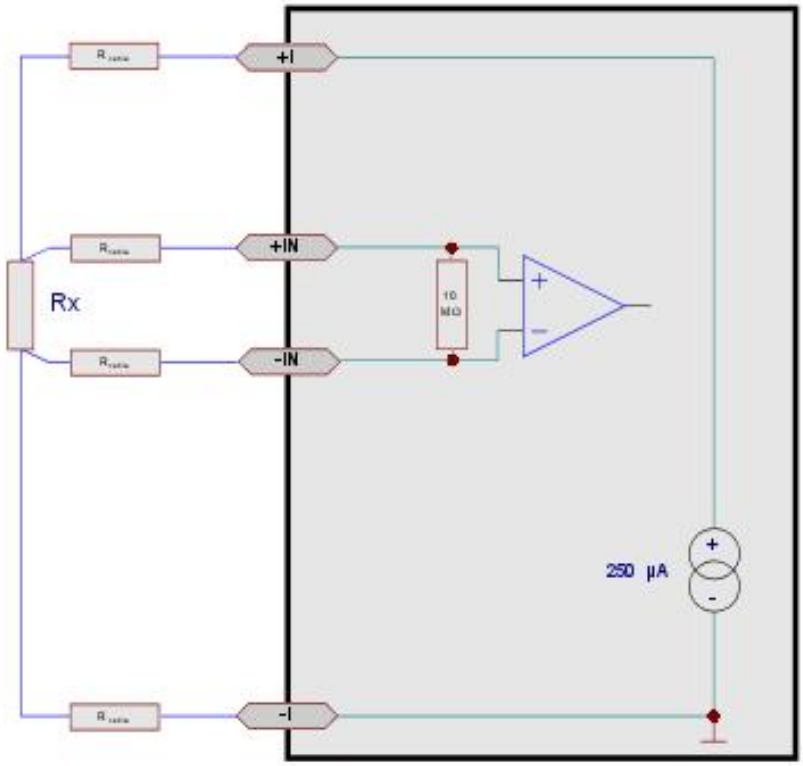
6.5.3.1 Measurement with PT100 (RTD) (Type LEMO)

With the LEMO terminals at the IP65 housing SL it's only possible to connect ***PT100 sensors*** directly in ***4-wire-configuration***. A (supplementary) reference current source feeds the sensor. How to connect a PT100 sensor is shown below.



Connection scheme of a PT100 sensor with LEMO terminals

6.5.4 Resistance measurement



For resistance measurement there are four input ranges: 0 to 1000Ω, 500 Ω, 250 Ω and 150 Ω. Each resistor is fed by a separate current source with approx. 250µA. The measurement uses 4-wire configuration.

The resistor is supplied by 2 lines (+I, -I). The other two measurement inputs (+IN, -IN) serve as Sense-leads. By using the Sense-leads, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

Probe-breakage recognition:

The indicated measurement value changes to zero if the connection between I+ and IN+ is broken. If only the connection to the resistor at IN+ is broken, the indicated value is the input range end value.

6.5.5 Optional sensor supply module

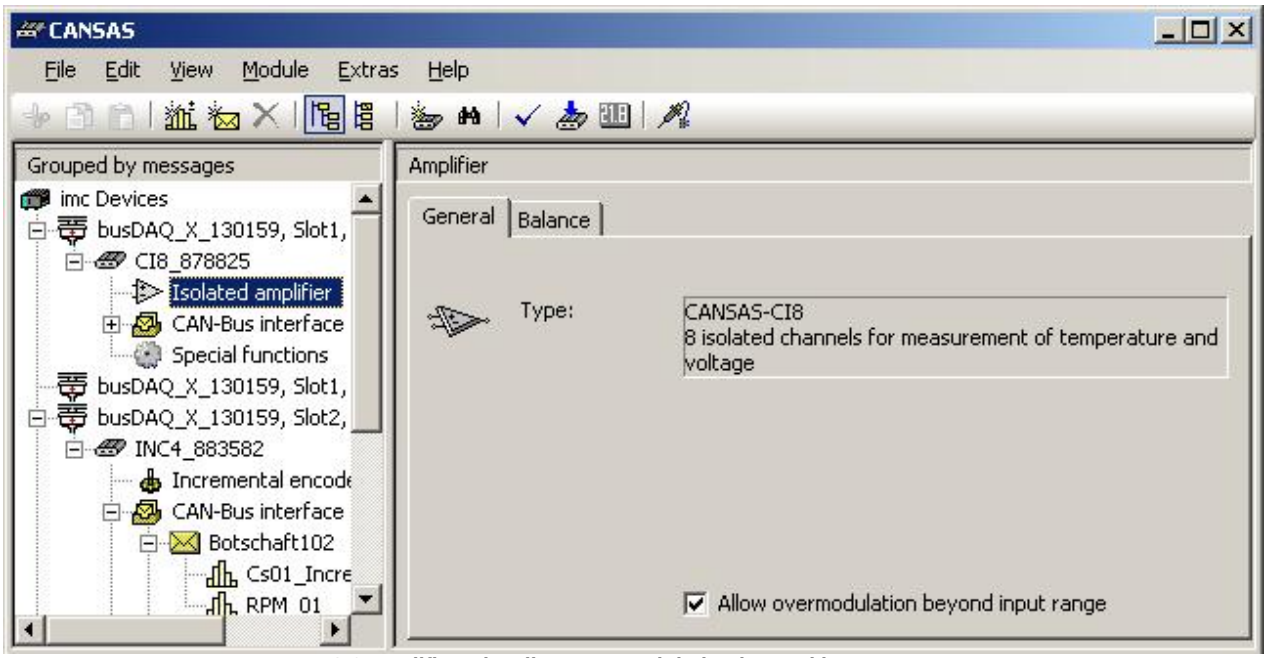
The CI8 can be enhanced with the sensor supply unit *SUPPLY*, which provides an adjustable supply voltage for active sensors.

The supply outputs are electronically protected internally against short circuiting to ground. The reference potential, in other words the sensor's supply ground contact, is the terminal GND. For the CANSAS-SL-CI8-L-SUPPLY there is only an unipolar voltage supply available.

For technical specification of the SUPPLY see here 427.

6.5.6 Allow overmodulation beyond input range

The option *Allow overmodulation beyond input range* on the Amplifier page of the dialog makes it possible to exceed the input range by about 20 %. This applies globally for all of the module's channels and for all measurement modes except for the temperature mode.



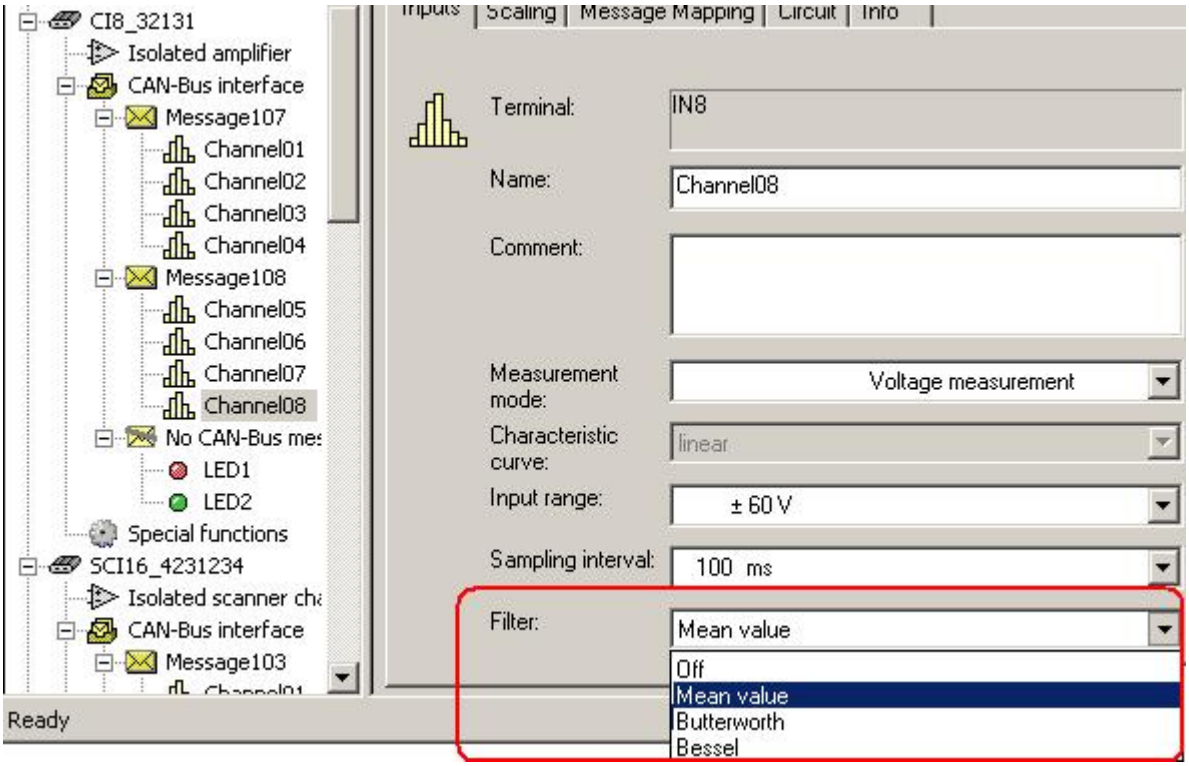
CI8 amplifier tab: Allow overmodulation beyond input range

If the measurement mode *"Voltage: allow zero-balance"* is selected, note that misunderstandings can arise because both functions use up the input range's headroom.

Note

- This operation type is not within the system's specs and can lead to saturation effects, distortions and non-linearities.
- This option has no effect on resistance measurement.

6.5.7 Filter



With CANSAS-CI8, the filter settings can be made for each channel separately.

Off: Last sampled value of a sample interval.

Mean value: The output value is averaged by (Sampling interval[ms] / 1 ms) samples. For temperature measurement, only this function is available.

Butterworth: The input signal is filtered by a Butterworth low pass filter 2nd. order. The cutoff frequency is 1/6 of the sample interval. For sampling intervals >= 2s only the mean value function will be used.

Bessel: The input signal is filtered by a Bessel low pass filter 2nd. order. The cutoff frequency is 1/6 of the sample interval. For sampling intervals >= 2s only the mean value function will be used.

Expert Settings:

When Expert Settings is activated, the order and cutoff frequency can be configured.

Filter	Order	lower cut off frequency	upper cut off frequency
Bessel	1	0,001 Hz	251 Hz
	2	0,004 Hz	251 Hz
	3	0,005 Hz	221 Hz
	4	0,005 Hz	251 Hz
Butterworth	1	0,001 Hz	251 Hz
	2	0,007 Hz	251 Hz
	3	0,009 Hz	251 Hz
	4	0,02 Hz	251 Hz

6.5.8 Connector plugs CI8

For the pin assignment of the DSUB-15 plugs see here 445.

6.5.8.1 SL Variety LEMO

see pin configuration of LEMO terminals 455.

6.6 DAC8 analog outputs

8 analog outputs

Parameter	Value (typ. / max.)	Remakrs
outputs	8	
configuration possibilities	voltage source current source	each channel separately configurable

Technical data DAC8. 392

6.6.1 General notes DAC8

The CANSAS-DAC 8 module has 8 digital / analog converters (DAC, D/A converters). This type of module's outputs can be configured as either voltage or current sources individual for every channel. The voltage range is from -10 V to +10 V at a resolution of 16 bits. The current supply works in the range from 0 to 20 mA and has 15-bit resolution. The outputs' refresh frequency is 10 kHz.

The output signal can be governed either by CAN-message or by internal logic. The outputs' status upon power-up is defined.

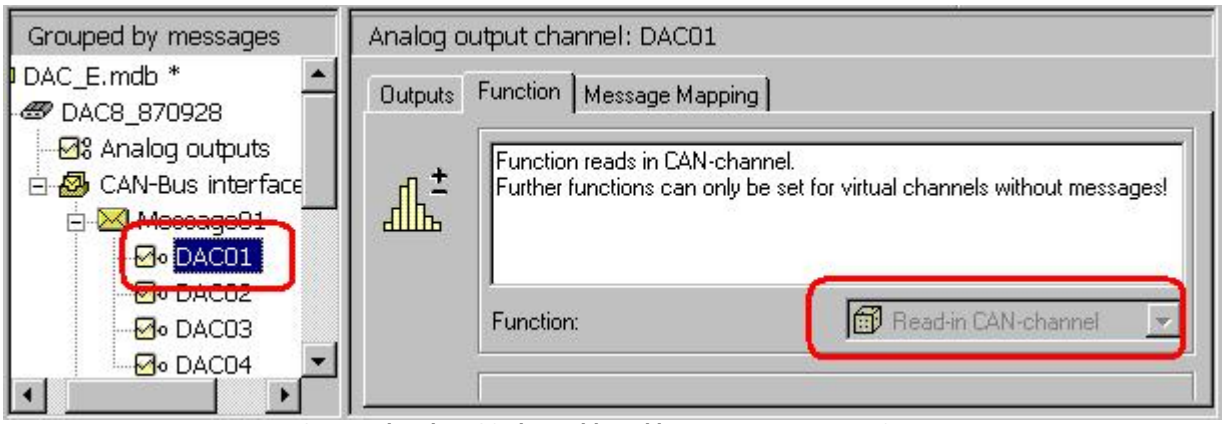
The 8 outputs have a common ground. Thus, they are not mutually isolated, but they are isolated from the voltage supply and the CAN-bus.

6.6.2 Analog portion

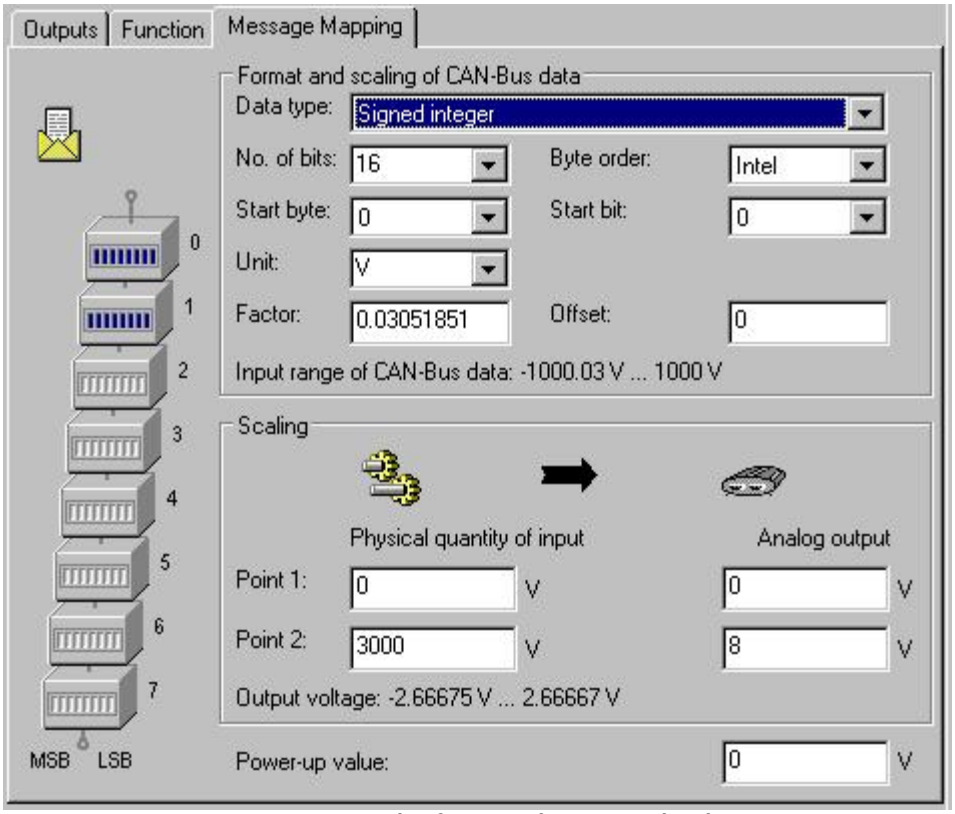
In the DAC8 module, the D/A converter outputs are not directly connected to the terminal plug. Instead, they are connected via a 2^{nd} order Butterworth filter with a cutoff frequency of 5 kHz. This suppresses "glitches" (typical spurious impulses experienced by D/A converters upon power-up) and the otherwise very angular signal shape is rounded. A signal shape thus results which appears more natural and doesn't display the otherwise typical staircase look. This also reduces the harmonics in the signal.

Additionally, there is a relay connected in front of each output. The relay only closes after the transients in the D/A converter and the filter have subsided, which appear upon activation of the module.

6.6.3 Linking the output signal to a CAN-message



Output signal DAC01 is positioned in message "Message01".
The function set is always "Read-in CAN-channel"



Message mapping for an analog output signal

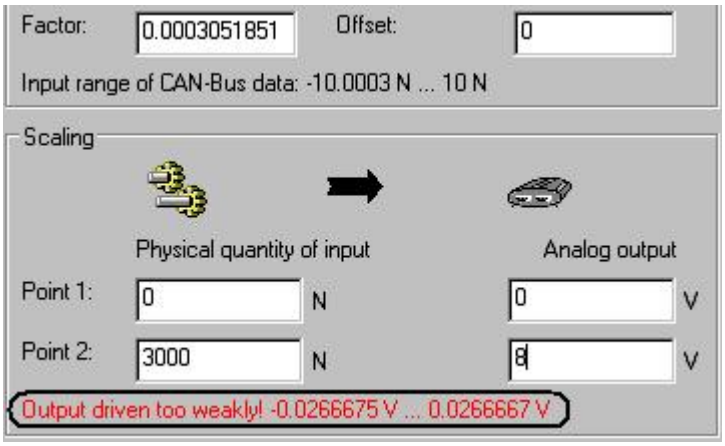
6.4.4 Message Mapping

To begin, the expected numerical range is to be defined. The available choices for ***Data type*** include signed and unsigned integers and a digital bit. Specify the resolution of the numbers as the ***No. of bits*** (8, 12 or 16 bits). The number's position within the message must also be determined, meaning in which Byte and at which of the Byte's bits. For the scaling, the selected ***Unit*** is entered in the dialog's lower portion. The scaling ***Factor*** for a 16-bit quantity is computed thus:

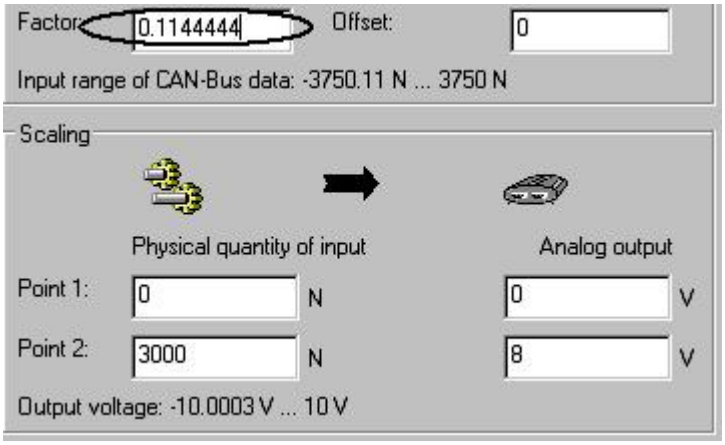
$$\text{Scaling factor} = \frac{\text{maximum value} - \text{minimum value}}{65535} \quad \text{for unsigned integers} \qquad \text{Offset} = \text{minimum value}$$

$$\text{Scaling factor} = \frac{\text{maximum value} - \text{minimum value}}{32767-(-32767)} \quad \text{for signed integers}$$

Offset = minimum value - scaling factor * (-32767)



The value range on the CAN-bus, set by the control ***Analog output***, is between 0 V and +8 V in the example shown. The physical input quantity has been set to range from 0N to 3000N. Taken together with the scaling factor specified in the control higher up in the dialog, the resulting possible output voltage range is –2,667 V to +2,667 V. This means that the maximum output voltage range isn't being utilized.

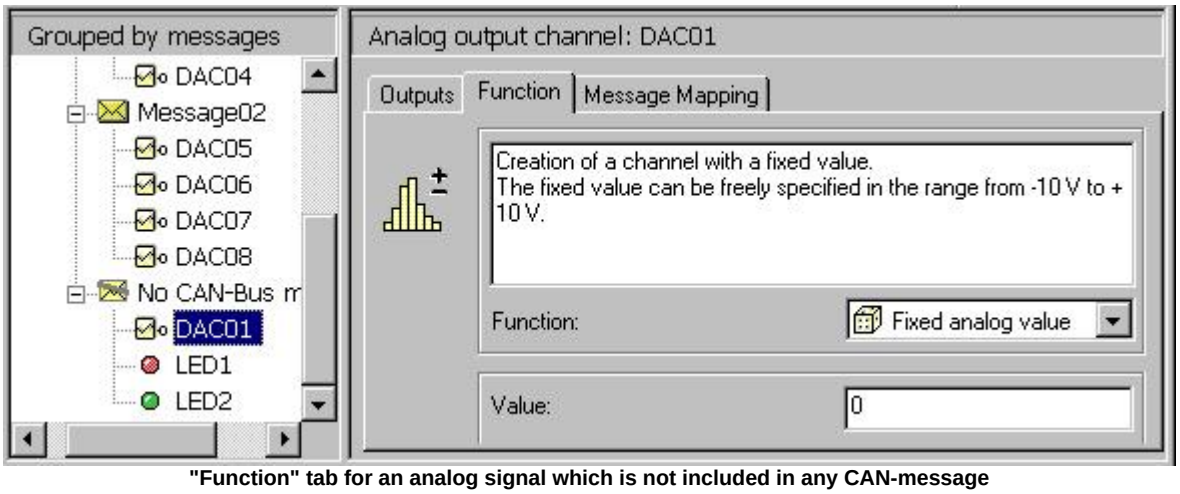


For ideal utilization of the DAC, the scaling factor must be selected to result in an output range of 10 V to +10V:

Although it is possible to set an output voltage range of, for instance, -20 V to +20 V, but any specification over ±10 V will be limited to ±10 V.

6.4.5 Calculating the output signal

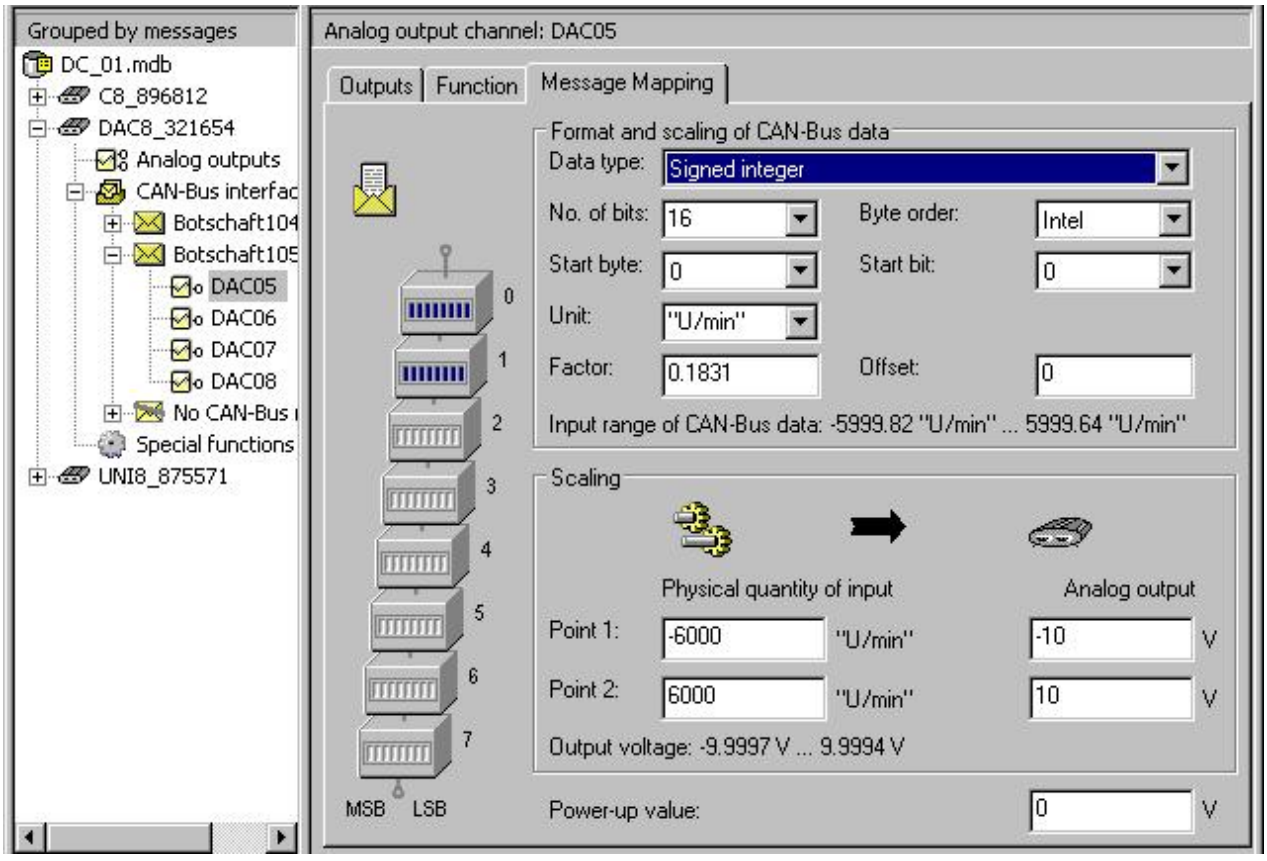
If the output signal is not assigned to any CAN message (the entry for this is located in the module tree under the node "Without CAN-bus message"), the signal can be devised to correspond to a calculation. For this purpose, functions are provided which can also be applied to the virtual channels (see the chapter "Virtual Channels 67"). When an analog output signal is removed from a CAN-message, then by default, the function "Fixed analog value" is assigned to it. However, a different function can be selected. In the following example, the 3rd output is set to take the fixed value 0 V.



"Function" tab for an analog signal which is not included in any CAN-message

The example below demonstrates how an rpm-value in the range –6000RPM to +6000RPM is read into the CAN-bus and outputted at DAC05.

The dialog shows the corresponding CAN-bus settings:



In this example, a 16-bit measurement quantity, scaled so that its minimum is -6000 and its maximum is +6000, is read into the CAN-bus.

The initial value (power-up value) is set to 0 V. After the unit is activated, the output DAC05 is held to the value 0 V, until a CAN-bus message arrives. Only once a message arrives, the converted value replaces the initial value.

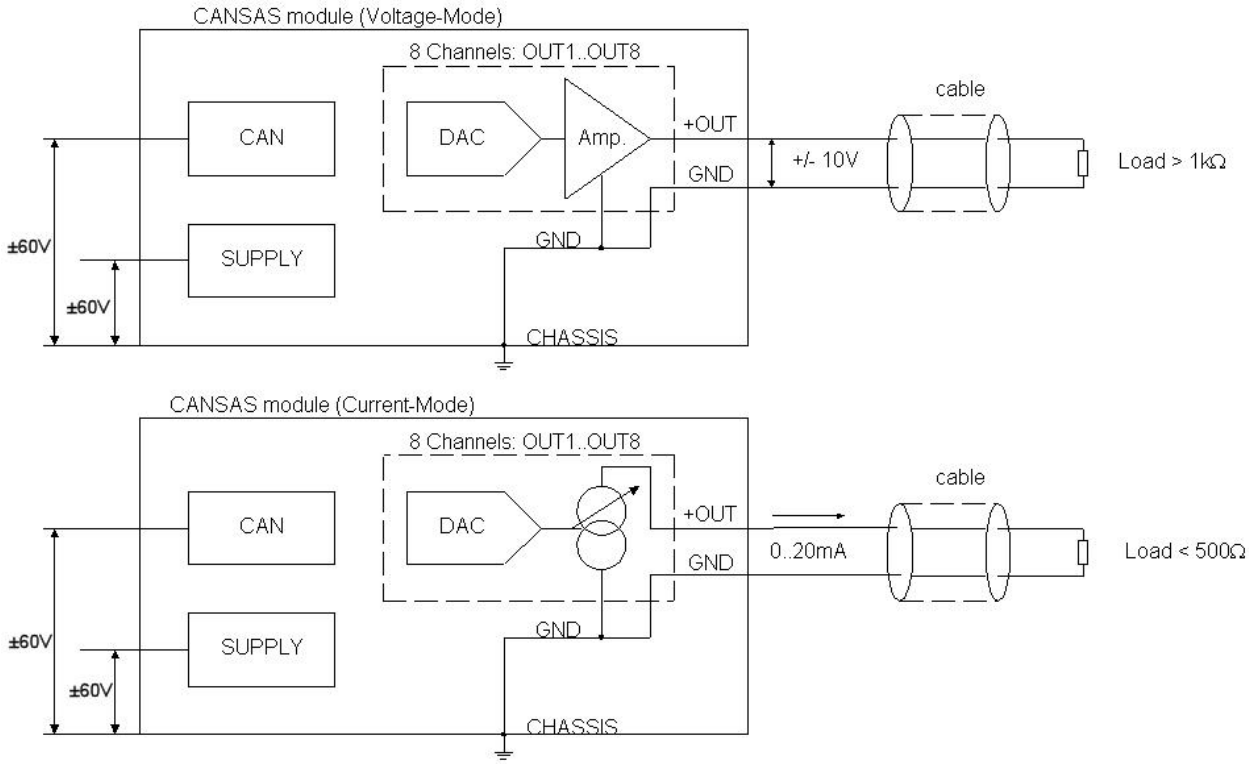
6.6.6 Configuring the outputs

The CANSAS-DAC8 module's outputs can be configured either as voltage or current sources. The corresponding settings are made in the dialog accessed via the Module Tree entry **Analog outputs**.

The default is voltage output.

If the setting is switched to current source, note the following: the module remains configured as for outputting voltage in the range -10V to +10 V. However, values which would otherwise be outputted as +10 V are instead outputted as a current of 20 mA, and values which would otherwise be transformed as 0 V become 0 mA. The current range is always positive, since the current source can only drive a current in one direction. Therefore, values otherwise mapped to negative voltages are ignored in current output mode.

6.6.7 CANSAS-DAC8 block diagram

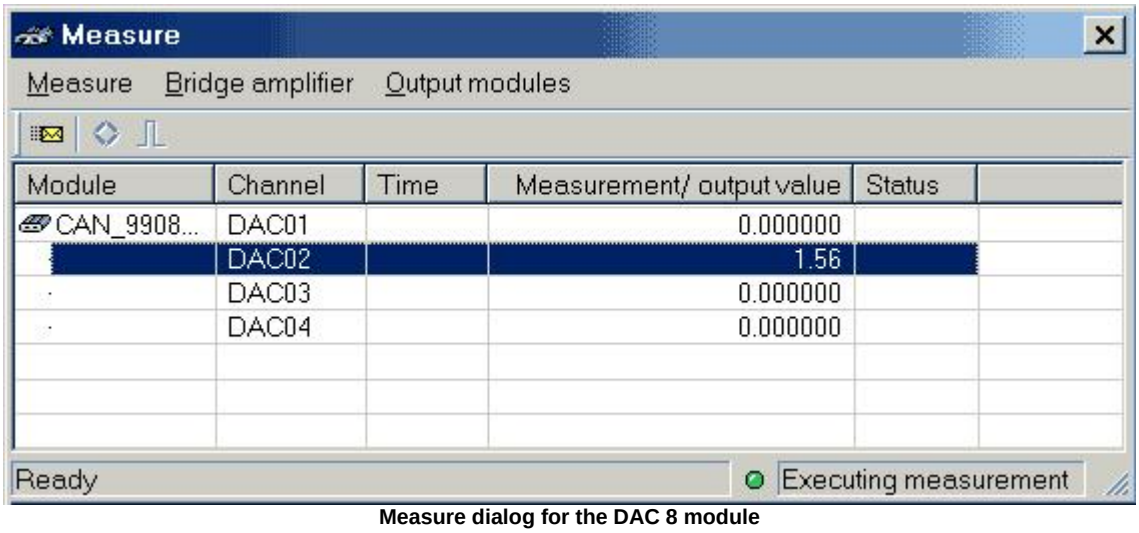


☞ **Note**

- If the module's outputs are voltages (upper figure), make sure that the load impedance never falls below 1kΩ or that the load current never exceeds 10 mA. For current output (lower figure), a load impedance below 500Ω must be set. This limits the voltage at the current's source to 10 V.
- The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN-bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.
- It is generally recommended to connect the housing (chassis) to ground (protective grounding line). The housing mainly consists of conduction material and is connected with GND.
- The DAC8 module's analog outputs are usually connected to the voltage or current inputs of other devices. Make sure that no ground loops are created as a consequence.
- It is highly recommended that the cables containing the analog leads be shielded. The DAC8 module's plug is provided with a shielding terminal.

6.6.8 Taking measurements with the analog output modules

In the dialog **Measure**, the analog output bits of a DAC8 module are listed only if they are assigned to a CAN-message. In such cases, the entry for the **Measurement/ output value** represents the signal's output value. Upon the start of the measurement, the **Power-up value** is displayed. The output signal can be influenced by editing the values in the column **Measurement/ output value**. By double-clicking in these cells, the editing mode is activated, and the value for the analog bits can be toggled between 0 and 1. When the ENTER-key is then pressed, the value is checked, accepted and sent to the module.



Measure dialog for the DAC 8 module

For output modules, the items **Transfer all values** and **Transfer value after editing** under the **Output modules** menu are available.

Transfer value after editing: This function can be toggled on and off. If it is active, then any editing performed on the entry is immediately sent to the module. If the function is off, the new value becomes valid but is not transferred. This way, it is possible to set multiple bits and then transfer them as a unit by using the function Transfer all values.

Transfer all values: This function transfers the output values of all output modules shown in the window to the modules.

6.6.9 Connector plugs DAC8

For the pin assignment of the DSUB-15 plugs see here 445.

6.6.9.1 Pin configuration ITT VEAM (CANSAS-L-DAC8-V)

ITT VEAM PIN	AO 1	AO 2	AO 3	AO 4	AO 5	AO 6	AO 7	AO 8
A								
B								
C	OUT1	OUT2	OUT3	OUT4	OUT5	OUT6	OUT7	OUT8
D	GND	GND	GND	GND	GND	GND	GND	GND
E								
F								
G	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS

☞ **Note**

- The ***CANSAS-K-DAC8*** module is connected via BNC terminals.

6.7 DCB8

Parameter	typ.	min. / max.	Remarks
Inputs	8		
Measurement modes	• Voltage measurement • Bridge sensors • Bridge: strain gauges		

Technical Data DCB8. 393

The eight measurements inputs IN1 to IN8 whose terminals are 4 DSUB plugs are for voltage- and bridge measurement. They are **non-isolated diffenrential amplifiers**. They share a common voltage supply for sensors and measurement bridges.

The DCB8 module is also available in the PROTECT model, having ESD and transients protection. See the description of the UNI8 355 for properties and information on its constraints.

6.7.1 Bridge measurement

Measurement of **measurement bridges** such as strain gauges.

The measurement channels have an adjustable DC voltage source which supplies the measurement bridges. The supply voltage for a group of eight inputs is set in common. The bridge supply is asymmetric, e.g., for a bridge voltage setting of V_B=5 V, Pin +*VB* (C) is at +VB =5 V and Pin -*VB* (D) at -VB =0 V. The terminal –*VB* is simultaneously the device's ground reference.

Per default 5 V and 10 V can be selected as bridge supply. Depending on the supply set, the following **input ranges** are available:

Bridge voltage [V]	Measurement range [mV/V]
10	±1000 to ±0.5
5	±1000 to ±1

Fundamentally, the following holds: For equal physical modulation of the sensor, the higher the selected bridge supply is, the higher are the absolute voltage signals the sensor emits and thus the measurement's **signal-to-noise ratio** and drift quality. The limits for this are set by the maximum available current from the source and by the **dissipation** in the sensor (temperature drift!) and in the device (power consumption!)

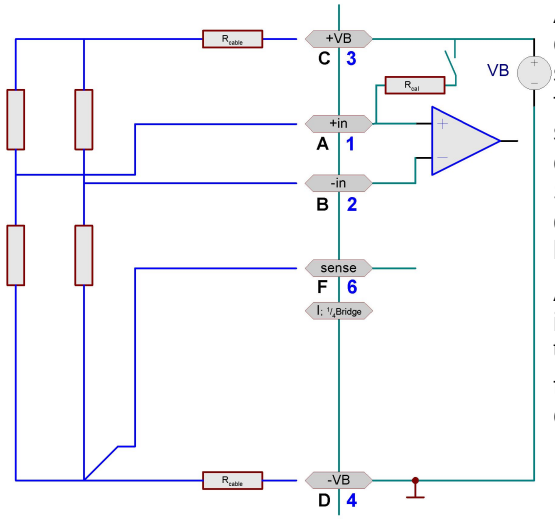
- For typical measurements with **strain gauges**, the ranges 5 mV/V to 1 mV/V are particularly relevant.
- There is a maximum voltage which the **Potentiometer** sensors are able to return, in other words max. 1 V/V; a typical range is then 1000 mV/V.

Bridge measurement is set by selecting as measurement mode either *Bridge: Sensor* or *Bridge: Strain gauge* in the operating software. The bridge circuit itself is then specified under the tab *Bridge circuit*, where quarter bridge, half bridge and full bridge are the available choices.

Note

We recommend to angle a maximum range on the not used voltage measurement. An open entry in half- or quarter bridge mode can annoy the neighbor channels if this is also in half- or quarter bridge mode.

6.7.1.1 Full bridge



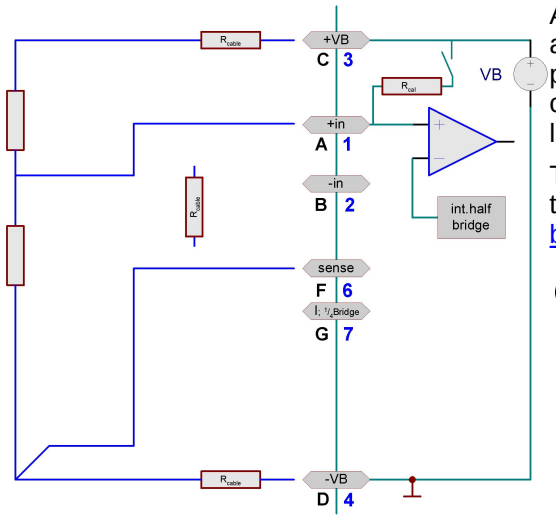
A full bridge has four resistors, which can be four correspondingly configured strain gauges or one complete sensor which is a full sensor internally. The full bridge has five terminals to connect. Two leads +*VB*(C) and -*VB*(D) serve supply purposes, two other leads +*in* (A) and -*in*(B) capture the differential voltage. The fifth lead *sense*(F) is the Sense lead for the lower supply terminal, which is used to determine the single-sided voltage drop along the supply line.

Assuming that the other supply cable +*VB*(C) has the same impedance and thus produces the same voltage drop, no 6 th lead is needed. The Sense lead makes it possible to infer the measurement bridge's true supply voltage, in order to obtain a very exact measurement value in mV/V.

Please note that the maximum allowed voltage drop along a cable may not exceed approx. 0.5 V. This determines the maximum possible cable length.

If the cable is so short and its cross section so large that the voltage drop along the supply lead is negligible. In this case the bridge can be connected at four terminals by omitting the Sense line.

6.7.1.2 Half bridge



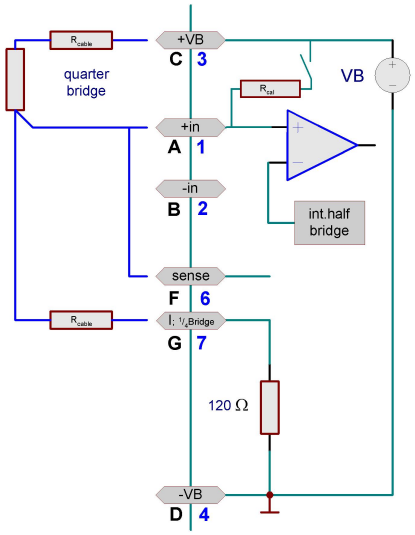
A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has 4 terminals to connect. For information on the effect and use of the Sense lead *sense* (F), see the description of the full bridge.

The amplifier internally completes the full bridge itself, so that the differential amplifier is working with a genuine full bridge 254.

Note

It is important that the measurement signal of the half bridge is connected to +*IN* (A). The *IN* (B) access leads to implausible measured values and influences the neighbor channels.

6.7.1.3 Quarter bridge



A quarter bridge can consist of a single strain gauge resistor, whose nominal value can be 120 Ω or 350 Ω.

For quarter bridge measurement, only 5 V can be set as the bridge supply.

The quarter bridge has 3 terminals to connect. Refer to the description of the full bridge for comments on the Sense lead. However, with the quarter bridge, the Sense lead is connected to *+in* (A) and *sense*(F) jointly.

If the sensor supply is equipped with the option “±15 V”, a quarter bridge measurement is not possible. The pin *I_1/4B* for the quarter bridge completion is used for–15 V instead.

Note

By default there is an internal 120 Ω completion resistor for bridge measurement. A 350 Ω completion resistor for quarter bridge measurement is possible as an alternative. When using this option, the scope of available function is limited:

- No direct current measurement is possible with the included default connector ACC/DSUB-UNI2, but it is possible only with the optional connector ACC/DSUB-I2 with a 50 Ω shunt resistor (differential measurement).

6.7.1.4 Sense and initial unbalance

The ***SENSE*** lead serves to compensate voltage drops due to cable resistance, which would otherwise produce noticeable measurement errors. If there are no sense lines, then ***SENSE*** (F) **must be connected** in the terminal plug according to the sketches above.

Bridge measurements are relative measurements (**ratiometric procedure**) in which the fraction of the bridge supply fed in which the bridge puts out is analyzed (typically in the 0.1% range, corresponding to 1 mV/V). Calibration of the system in this case pertains to this ratio, the bridge input range, and takes into account the momentary magnitude of the supply. This means that the **bridge supply's actual magnitude is not relevant** and need not necessarily lie within the measurement's specified overall accuracy.

Any **initial unbalance** of the measurement bridge, for instance due to mechanical pre-stressing of the strain gauge in its rest state, must be zero-balanced. Such an unbalance can be many times the input range (bridge balancing). If the initial unbalance is too large to be compensated by the device, a larger input range must be set.

Possible initial unbalance

input range [mV/V]	bridge balancing (VB = 2.5 V) [mV/V]	bridge balancing (VB = 5 V) [mV/V]	bridge balancing (VB = 10 V) [mV/V]
±1000	200	500	150
±500	200	100	250
±200	30	100	50
±100	30	15	50
±50	6	15	7
±20	20	3	7
±10	20	10	15
±5	7	10	5
±2	9	3	5
±1	-	4	5
±0.5	-	-	-

6.7.1.5 Balancing and shunt calibration

The amplifier offers a variety of possibilities to trigger bridge balancing:

- Balancing / shunt calibration upon activation (cold start) of the unit. If this option is selected, all the bridge channels are balanced as soon as the device is turned on.
- Balancing / shunt calibration via the on the *Amplifier balance* tab.
- In shunt calibration, the bridge is unbalanced by means of a 174.66 kΩ shunt. The results are:

Bridge resistance	120 Ω	350 Ω
174.7 kΩ	0.171 mV/V	0.5005 mV/V

The procedures for balancing bridge channels also apply analogously to the voltage measurement mode with zero-balancing.

☞ **Note**

- We recommend setting channels which are not connected for voltage measurement at the highest input range. Otherwise, if unconnected channels are in quarter- or half-bridge mode, interference may occur in a shunt calibration!
- If you have a measurement device which uses imcDevices software, you also see the application examples in the Field Busses chapter. There you will find examples which illustrate how to perform a shunt calibration or adjustment. Owners of µ-MUSYCS receive the pertinent excerpt upon request.
- For the special case of shunt calibration: If at least one channel is set to voltage, and zero-point adjustment, and no channel is set to bridge or strain gauge, then upon triggering of a shunt calibration both the status and the LED_function status indicate a shunt calibration, but it is not carried out. By contrast, when adjustment is set, it is indicated after being triggered and also carried out.
- **Note that importing a changed configuration to the module deletes any previously performed bridge balancing and resets it to zero. Therefore, always repeat bridge balancing after importing a configuration!**

6.7.2 Voltage measurement

- Voltage: ±10 V to ±5 mV in 9 different ranges

The input impedance is 20 MΩ. (1 MΩ when switched off)

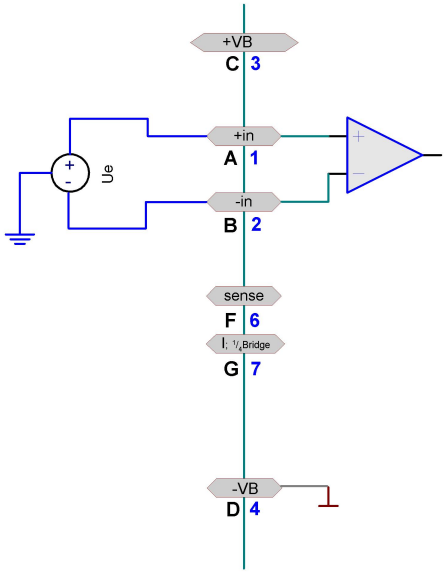
6.7.2.1 Voltage source with ground reference

The voltage source itself already has a connection to the device's ground. The potential difference between the voltage source and the device ground must be fixed.

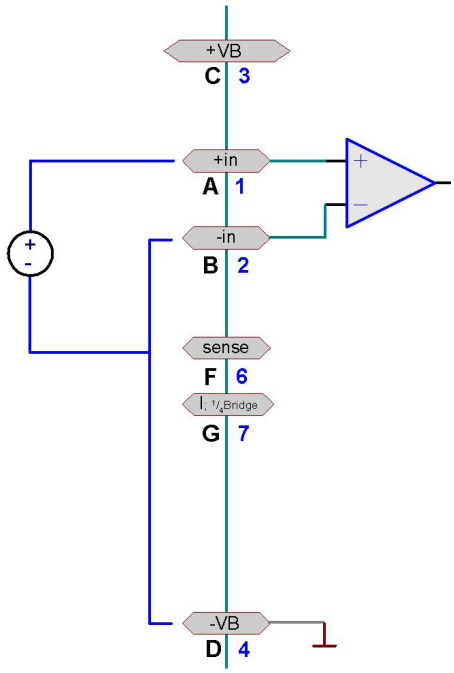
Example: The device is grounded. Thus, the input -*VB (*D) is also at ground potential. If the voltage source itself is also grounded, it's referenced to the device ground. It doesn't matter if the ground potential at the voltage source is slightly different from that of the device itself. But the maximum allowed common mode voltage must not be exceeded.

Important: In this case, the negative signal input -*in* (B) may not be connected with the device ground -*VB (*D). Connecting them would cause a ground loop through which interference could be coupled in.

In this case, a genuine differential (but not isolated!) measurement is carried out.



6.7.2.2 Voltage source without ground reference

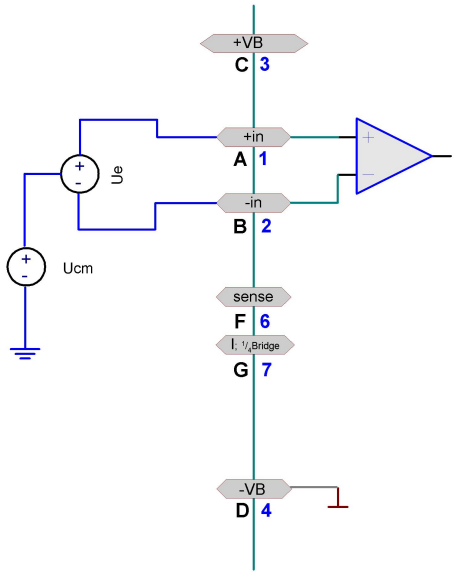


The voltage source itself is not referenced to the device ground but is instead isolated from it. In this case, a ground reference must be established. One way to do this is to ground the voltage source itself. Then it is possible to proceed as for "Voltage source with ground reference". Here, too, the measurement is differential. It is also possible to make a connection between the negative signal input and the device ground, in other words to connect *-in* (B) and *-VB*(D).

Example: An ungrounded voltage source is measured, for instance a battery whose contacts have no connection to ground. The module is grounded.

Important: If *-in*(B) and *-VB*(D) are connected, care must be taken that the potential difference between the signal source and the device doesn't cause a significant compensation current. If the source's potential can't be adjusted (because it has a fixed, overlooked reference), there is a danger of damaging or destroying the amplifier. If *-in*(B) and D are connected, then in practice a single-ended measurement is performed. This is no problem if there was no ground reference beforehand.

6.7.2.3 Voltage source at a different fixed potential



The common mode voltage (U_{cm}) has to be less than ±10 V. It is reduced by ½ input voltage.

Example: Suppose a voltage source is to be measured which is at a potential of 120 V to ground. The device itself is grounded. Since the common mode voltage is greater than permitted, measurement is not possible. Also, the input voltage difference to the device ground would be above the upper limit allowed. For such a task, the *DCB8* cannot be used!

6.7.2.4 Voltage measurement: With zero-adjusting (tare)

In voltage measurement, it is possible for the sensor to have an initial offset from zero. For such cases, use the operating software to select the measurement mode "Voltage enable offset calibration" for the desired channel. The measurement range will be reduced by the offset correction If the initial offset is too large for compensation by the device, a larger input range must be set.

6.7.3 Sensor supply

The *DCB8*channels are enhanced with an integrated sensor supply unit, which provides an adjustable supply voltage for active sensors. The supply outputs are electronically protected internally against short circuiting to ground. The reference potential, in other words the sensor's supply ground contact, is the terminal GND.

The supply voltage can only be set for a group of eight channels.

The supply outputs are electronically protected internally against short circuiting to ground. The reference - potential, in other words the sensor's supply ground contact, is the terminal GND.

The voltage selected is also the supply for the measurement bridges. If a value other than 5 V or 10 V is set, bridge measurement is no longer possible!

Note

- Before a sensor will be connected, make sure the voltage supply has been set correctly (not too high). Therefore the voltage supply must be set and configured using the software. Then the sensor can be connected. Otherwise the sensor and the CANSAS-module could be damaged.
- There is a 5 V pin at the imc connector. That voltage is not available for the CANSAS-modules, only for CRONOS-PL!

The technical data of the sensor supply 393 is listed as part of the data sheet of CANSAS-DCB8.

6.7.4 Bandwidth

The channels' **maximum sampling rate** is 1 kHz (1 ms). The **analog bandwidth** (without digital low-pass filtering) is 200 Hz (-3 dB).

6.8 DI16 digital inputs

16 digital inputs

Parameter	Value (typ. / max)	Remarks
Inputs	16	common reference ground for each pair of channels, isolation to other channel pairs, to power supply and CAN-bus, but not within pair

Technical data DI16. 396

6.8.1 Overview

The CANSAS DI16 module has 16 digital inputs which can be sampled at up to 10 kHz. The inputs are arranged in pairs each having a common reference ground. The 2 inputs within a pair are not mutually isolated, but each pair is isolated from the other pairs, the chassis the power supply and the CAN-bus.

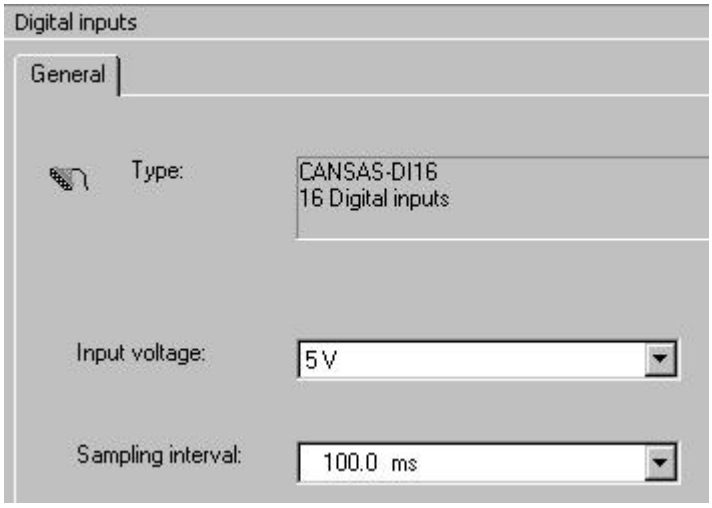
As well as each being sampled as single bit signals, the 16 digital inputs can all be sampled together as a digital word. For this purpose, a digital port can additionally be configured. If the entire port is sampled, it can return values from 0 (zero) to 65535, in other words it is interpreted as an unsigned 16-bit integer. However, if only a single bit is used, its data type is "digital" and it occupies only 1 bit on the CAN-bus.

6.8.2 Settings

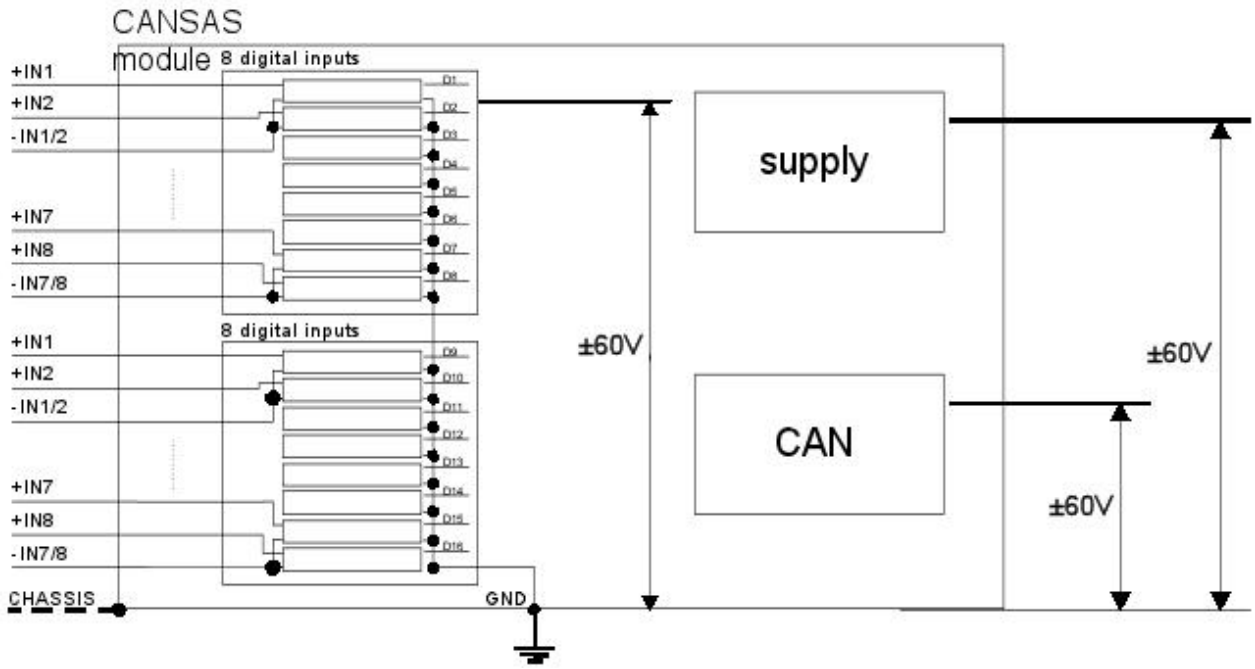
The properties which can be specified for the digital channels are Name and Comment.

In the dialog **digital inputs**, the properties applicable to all the digital channels are set.

Input voltage
The input voltage range for all the digital inputs can be toggled between 5 V (TTL-range) and the 24 V range.



6.8.3 Block diagram



☞ **Note**

- The CANSAS-DI16 module's inputs are organized in pairs which are isolated from other inputs. The pairs' own reference grounds are not connected to the DI16 module's internal ground or CHASSIS. Eight inputs are accessible per connection terminal.

- Open inputs are set to LOW "0".
- The board with the signal processor (DSP) is at internal ground potential GND. This is the module's internal "digital ground", and is connected to the chassis as well as to the shielding of the input plug. This internal electric potential must not "float" in relationship to the power supply or the CAN-bus. Rather, the maximum voltage differential of 50 V to GND must not be exceeded, so GND must be held at a suitable value. Otherwise, the module can sustain damage or malfunction. A chassis connection is provided in the form of the shielding terminal.
- An example for digital inputs: -IN7/8 is the shared ground connection for the inputs +IN7 and +IN8. This ground is not connected to the chassis.

- It is generally recommended to connect the housing (chassis) to ground (protective grounding line). The housing mainly consists of conduction material and is connected with DGND.

6.8.4 Sampling Interval

In this module, the sampling interval is set in common for all inputs.

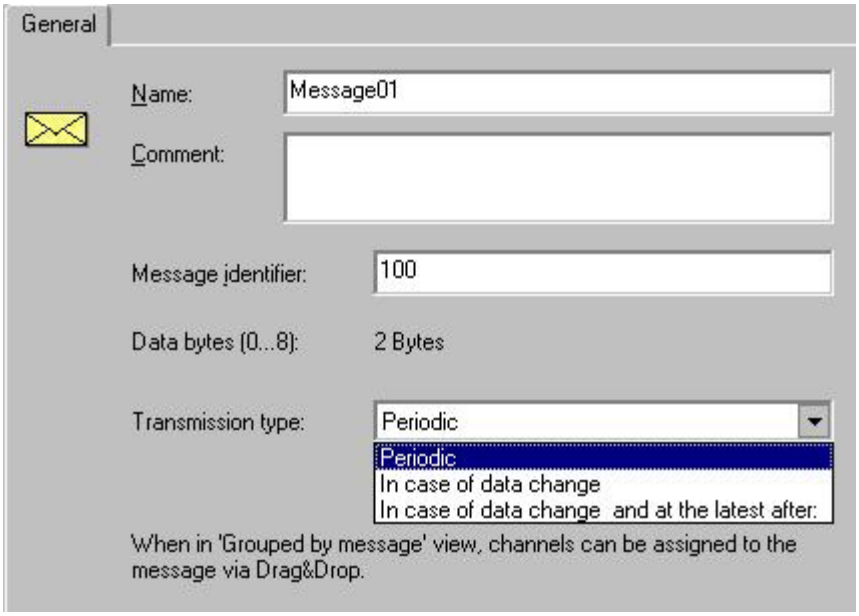
0,1 ms	1 ms	10 ms	100 ms	1 s	10 s	1 min
0,2 ms	2 ms	20 ms	200 ms	2 s	20 s	
0,5 ms	5 ms	50 ms	500 ms	5 s	30 s	

Note

The digital inputs are sampled at intervals of 0,1 ms, no matter what the specified sampling interval is. But afterwards the data is reduced to fit the specified sampling interval.

6.8.5 CAN-bus message dialog

The CAN-bus messages from the CANSAS DI16 module come with an extra setting:



Transmission type

This determines when messages are transmitted.

Periodic: At the rate set for the assigned channel.

In case of data change: The message is sent only if at least one value of the assigned channel's signal has changed since the last transmission.

In case of data change or at the latest after: The message is sent only if at least one value of the assigned channel's signal has changed since the last transmission or if a specified time interval elapses since the last transmission.

Card Message Mapping

Different bits can be joined together into ***bit groups***. The default entry *Automatic* means either no bit group membership or the first element of a group. If *extensions elements* are selected for subsequent bits, they belong to this group. In imcDevices, these grouped bits no longer appear as binary states but as unsigned integers."

Note

- The DI16 module is not equipped to evaluate pulse sequences from incremental encoders or to conduct precise time or frequency measurements. Due to its discrete pulse rate of 0,1 ms, the resolution is limited. For the tasks mentioned, the INC4 module is the suitable choice.

6.8.6 Connector plugs DI16

For the pin assignment of the DSUB-15 plugs see here 445.

Pin configuration of CANSAS-L-DI16-Ph and -K-DI16-Ph with Phoenix terminal blocks 457.

Pin configuration of CANSAS-L-DI16-V with ITT VEAM terminals 454.

6.9 DO16 digital outputs

16 digital outputs

Parameter	Value	Remarks
outputs	16	Separate voltage supply for each bank of 8 channels Each bank of 8 isolated to other bank, power supply and CAN-bus, but not isolated within bank

Technical data DO16. 397

6.9.1 Configuring the outputs

The CANSAS-DO16 module's outputs can be configured as open-drain or as totem-pole output stages. This setting applies to whole channel groups, meaning that Signals 1 through 8 share their settings, as do Signals 9 through 16. This setting must be made in the dialog accessed via the Module Tree entry **Digital outputs**.

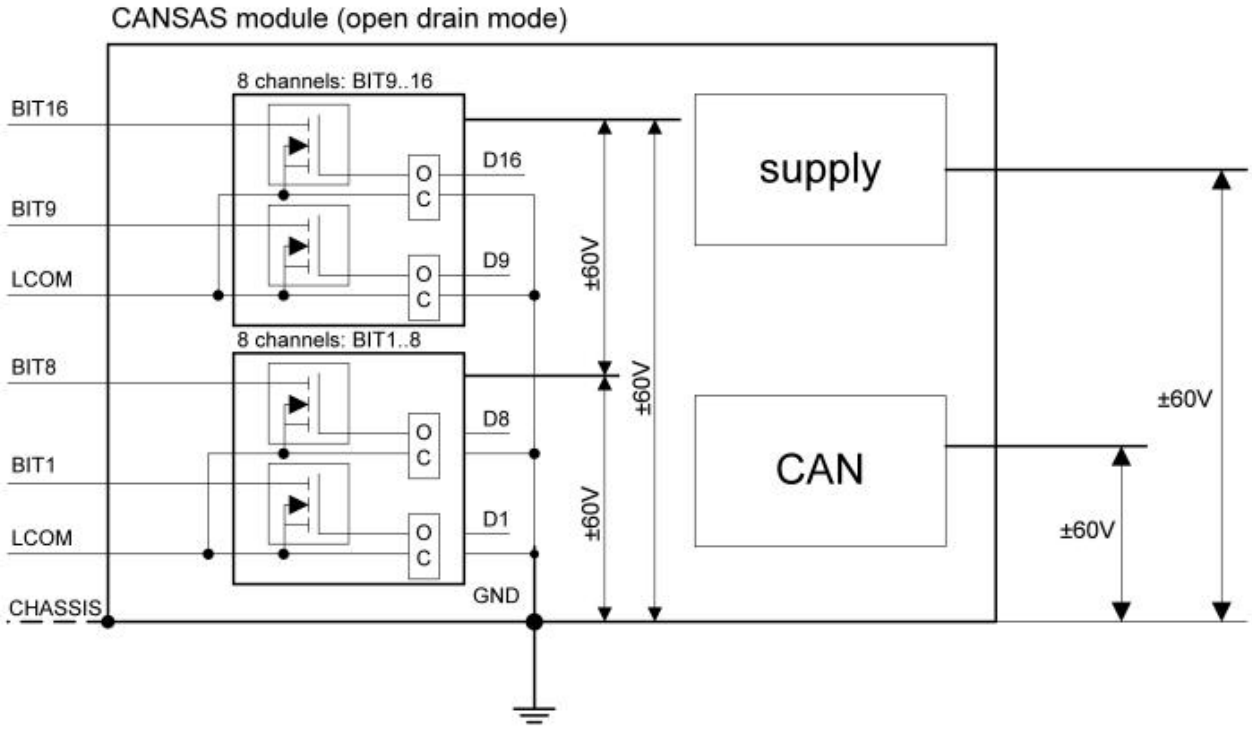
6.9.2 Starting up the DO16 module

When the module is started, the outputs are set to the value "0". If a power-up value other than 0 (zero) is set, it only comes into effect after the module has been activated. To boot the module typically takes < 1s. It is recommended to set "0" as the power-up value in the channel's message mapping dialog, if possible. Only then will there not be any jump after booting.

6.9.3 CANSAS-DO16 block diagram

6.9.3.1 Open Drain Mode

Outputs configured as Open drain

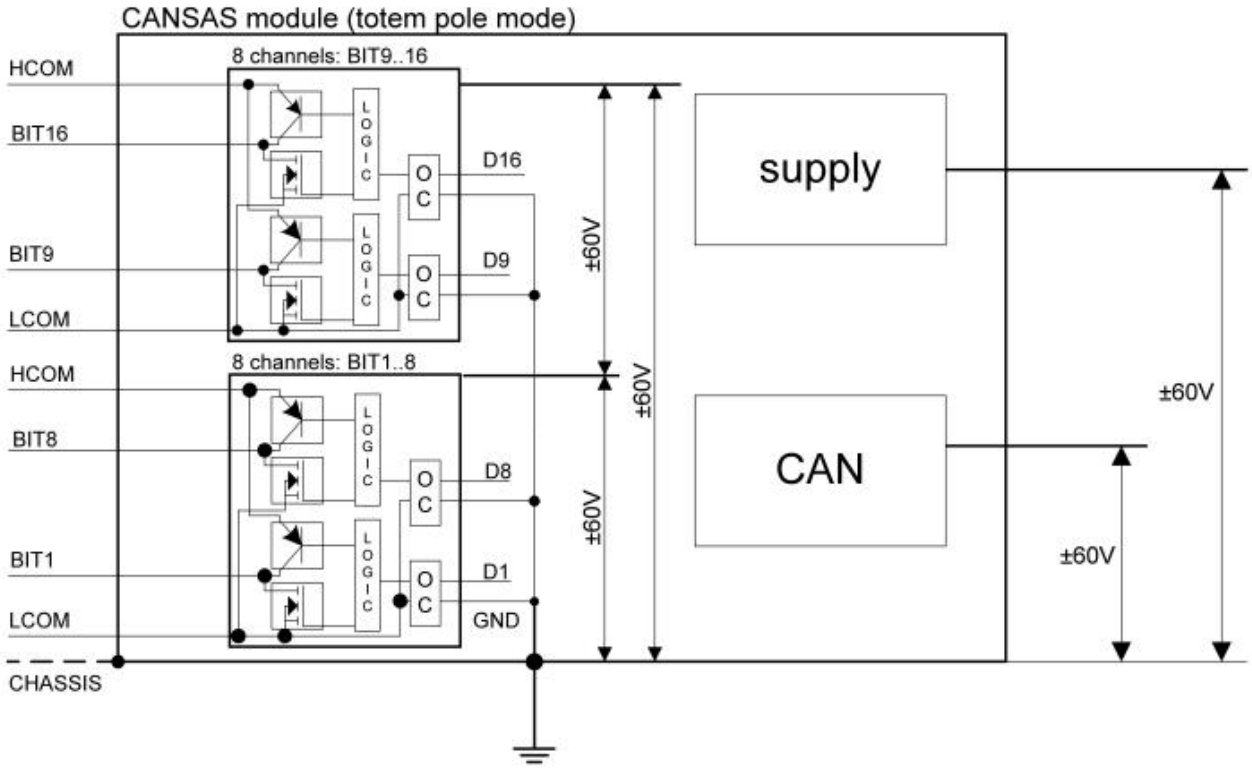


At the output of each channel x (denoted in the connection terminal by "Bit x"), there is a transistor configured as an open collector. When a target value of "0" (low) is output, the transistor is switched through (conducts). The result is that the output is connected to ground (denoted by LCOM in the connection terminal). For a target value of "1" (high) at the output, the transistor is closed (has high

impedance). In order for there to be a defined voltage in for this state, the output must be connected to the positive voltage supply via a load. HCOM's voltage differential to LCOM is 5 V and can take a small load; refer to the technical specs for more info. Instead of HCOM, an external source of (higher) voltage can be connected via the load or a pull-up resistor.

6.9.3.2 Totem-Pole Mode

Outputs configured as Totem-Pole



In totem pole mode the output is configured as a low-impedance driver switching between the two supply rails 0 V and 5 V.

For a target value of "1" (high), the internal supply voltage 5 V, referenced to LCOM, is applied to the output. If an external voltage > 5 V to LCOM is applied at HCOM's terminal, it is used instead of the internal 5 V. A voltage of 5 V is accessible at HCOM which can take a small load; refer to technical specs for details.

For a target value of "0" (low), the output is connected with LCOM and thus is at a differential of 0 V to LCOM (LCOM being the reference).

Each of the two plugs has its own independent references. LCOM is basically the plug's reference ground, and HCOM the plug's supply. LCOM comes from "Low" and "common", whereas HCOM comes from "High" and "common".

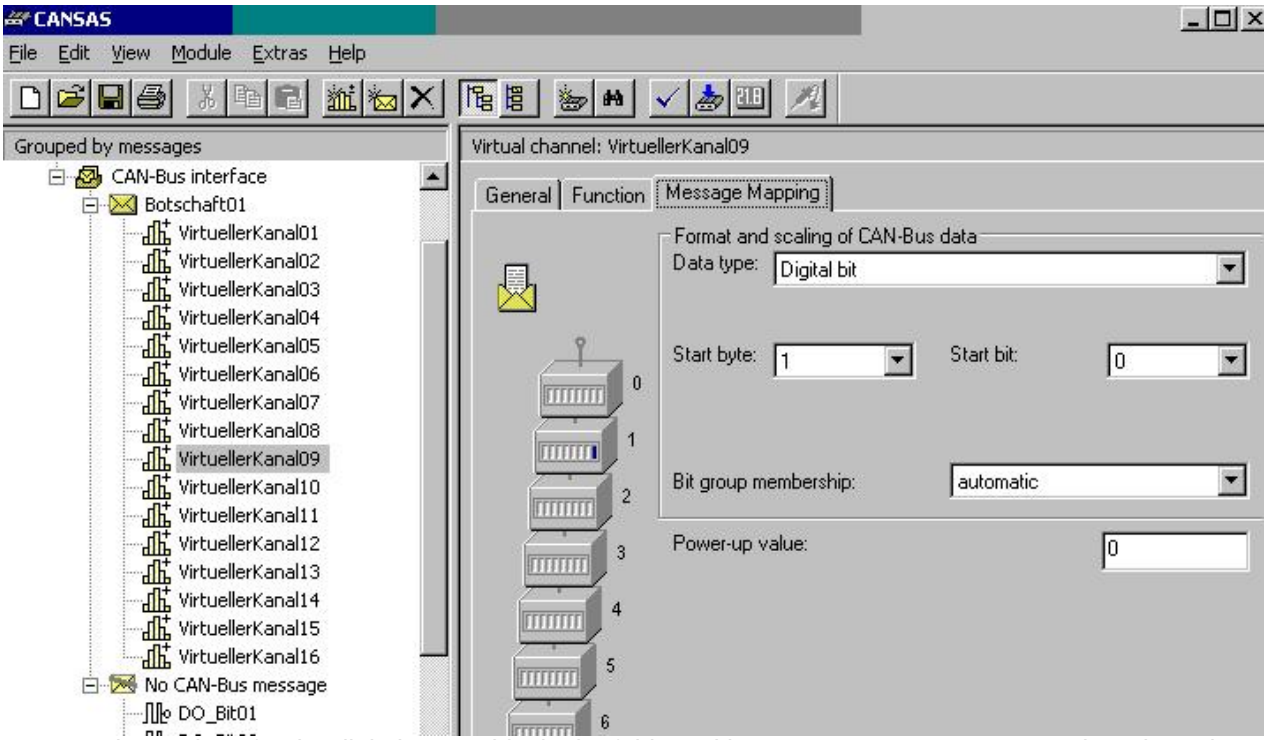
The terminal plug CON1 is access for Bits 1...8; CON2 for Bits 9...16.

6.9.4 Invert Output

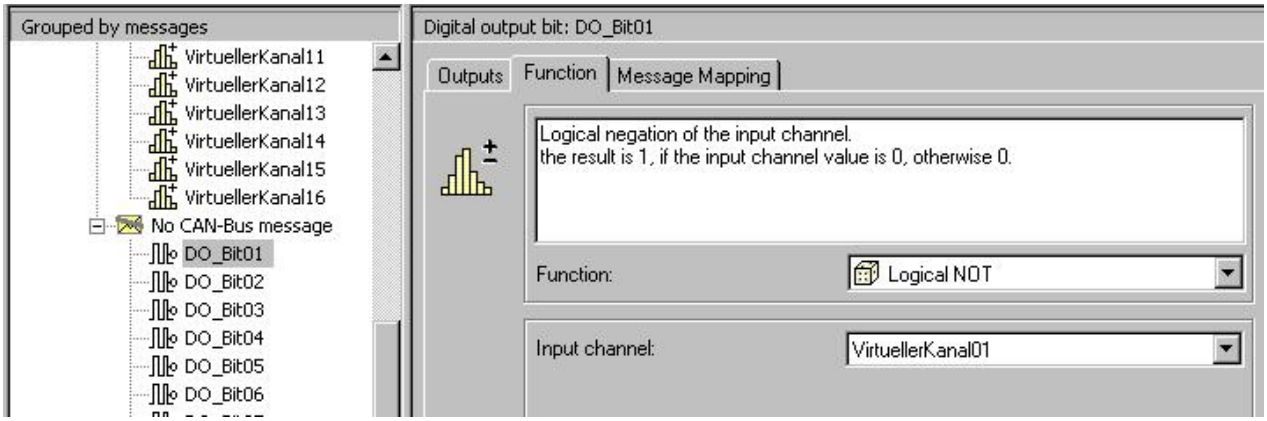
A setting in the CANSAS software enables inversion of the CANSAS DO16 logic. To do this, the following configuration steps are necessary (these instructions describe inversion of all 16 outputs):

1. The existing digital outputs (designated by default as *DO_Bit01 – DO_BIT16* in *Message01*) must be relocated to the folder *Without CAN-bus message*.
2. 16 virtual channels must be set up and relocated to *Message01*which previously contained the outputs.

3. The setting for the virtual channels on the page *Message mapping* are changed so that *VirtualChannel01* has start byte 0 and start bit 0, and until *VirtualChannel16* start byte 1 and start bit 7.



4. The settings for the digital output bits in the folder *Without CAN-Bus message* must be adapted so that the function *Logical NOT* and the input channel *VirtualChannel01* are assigned to output bit *DO_BIT01* on the dialog page *Function*. The other 15 channels must be treated analogously.



6.9.5 Connector plugs DO16

For the pin assignment of the DSUB-15 plugs see here 444.

Pin configuration CANSAS-L-DO16-Ph with Phoenix terminal blocks. 458

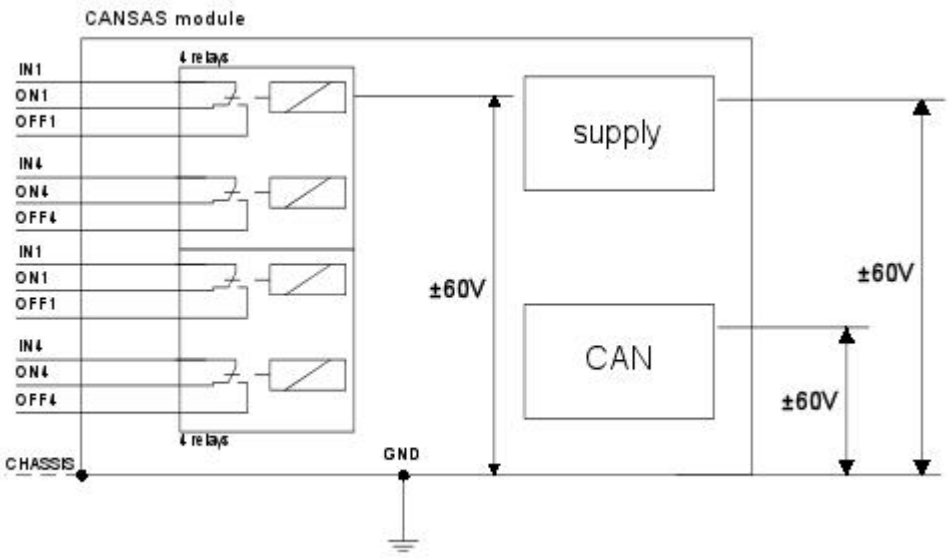
6.10 DO8R, -DO16R relay outputs

8/16 digital outputs

Parameter	Value (typ./max.)
Relays	8 DO8R 16 DO16R

Technical data DO8R, -DO16R. 398

6.10.1 block diagram DO8R, DO16R



Each terminal plug has four relays each having an opening contact and a closing contact. The input contacts are denoted by IN1...IN4, the openers by ON1...ON4 and the closers by OFF1...OFF4. The terminal plug CON1 is access for Bits 1...4 and CON2 for Bits 5...8.

Target value	Relay position
0 (low)	IN and ON connected
1 (high)	IN and ON not connected

The relays are single pole double throw switches.

6.10.2 Starting the DO8R, DO16R module

The relay's switching state is ON upon activating the DO8R-, DO16R-module. If a power-up value other than 0 (zero) is set on the CAN-board, it only comes into effect after the module has been activated. To boot the module typically takes < 1s.

If the software sets the value "0" as the rest state, the relays don't switch over after the system boots. If the user wishes "1" to be the rest state, we recommend that the relay's ON and OFF be connected the opposite way around, rather than setting the value by software.

6.10.3 Connector plugs DO8R, DO16R

CAN/DSUB-STD (Relais) is recommended and delivered per default. ACC/DSUB-REL4 can be used as replacement with swapped pinning for ON and OFF. For the pin assignment of the DSUB-15 plugs see here 445.

Pin configuration of CANSAS-L-DO8R-Ph with Phoenix terminal blocks 458.

Pin configuration of CANSAS-L-DO8R-V with ITT-VEAM terminals. 454

6.11 IGN ignition angle measurement module

Analog inputs for ignition angle, crankshaft sensor and reference signal

Parameter	Value (type/max.)	Remarks
Inputs	1	ignition signal
	1	crankshaft sensor
	1	reference signal

IGN technical specs 399

CANSAS-IGN is a module for determining the ignition angle of gasoline engines. The module has electrically insulated inputs for connecting the ignition signal, a crankshaft sensor and a reference signal. Based on the ignition time and the crankshaft position, the module determines the ignition angle and the engine's current rotation speed.

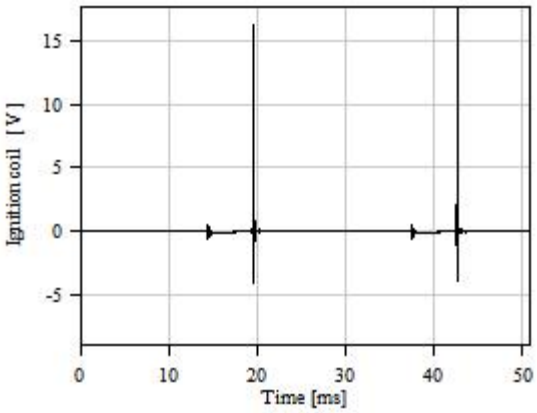
CANSAS-IGN

Ignition signal

The ignition signal is measured to determine the exact moment of ignition. Based on this time and the crankshaft position, the module determines the ignition angle.

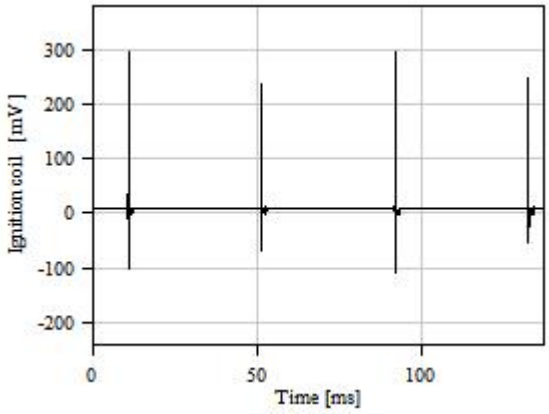
The ignition signal can be captured by **inductive transducers** (e.g. clamp ignition sensor).

The resulting signal contains the typical pointed and high pulses at the moment of ignition. The measurement is performed at the ignition coil's **secondary line**. The pulses can reach up to 100V.



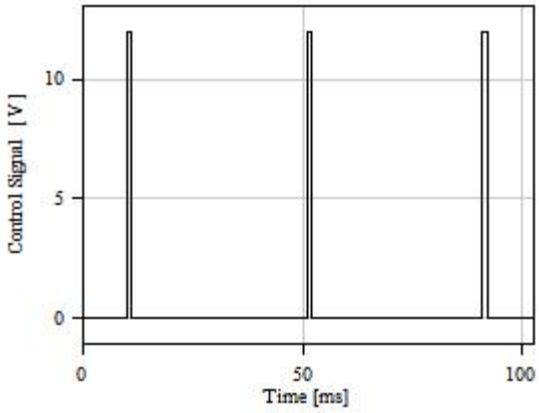
Ignition signal: High level

The ignition signal can also be captured at the ignition coil's **primary side** by means of a clamp ignition sensor. In that case the shape is similar, but the signal levels substantially lower:



Ignition signal: Low level

Direct signal capture at the control lines is also possible. In that case, this is generally a logic level:



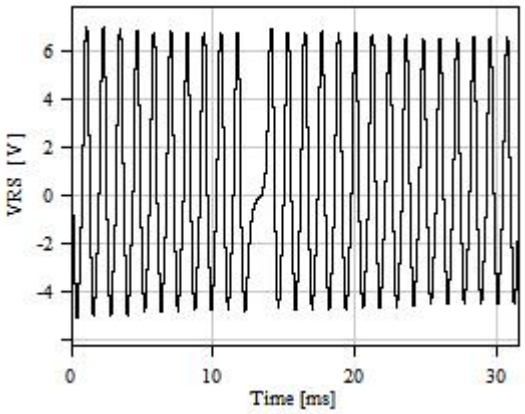
Ignition signal: Logic level

Crankshaft sensor

The reference angle is determined by means of a crankshaft sensor. The sensor determines the crankshaft's current position, in other words, its angle.

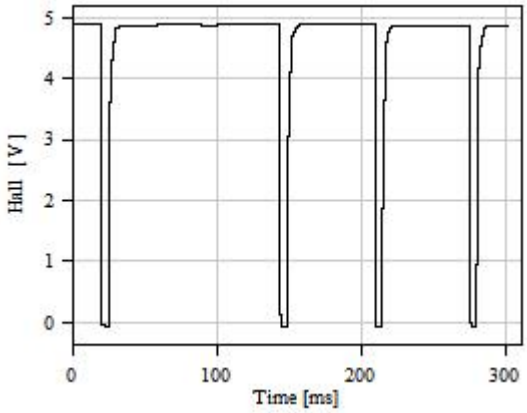
Possible sensors:

The typical case is an inductive approach sensor. this is the motor's own sensor working by the Variable Reluctance principle (VRS, variable reluctance sensor). The sensor samples the flywheel-cogwheel and returns one pulse per cog. Typically, one or two cogs will be missing to indicate the zero position. The signal's amplitude depends on the RPMs.



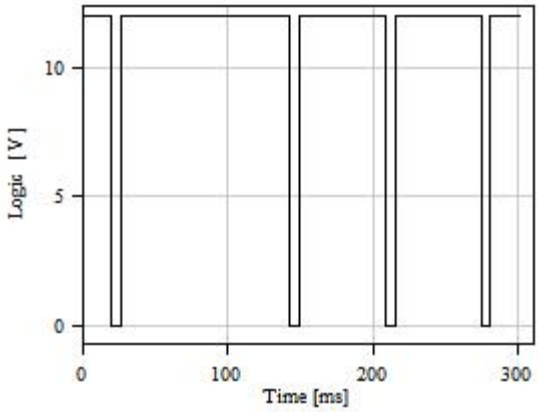
Motor's nuilt-in inductive pickup (VRS)

Alternatively, a Hall-sensor is used.



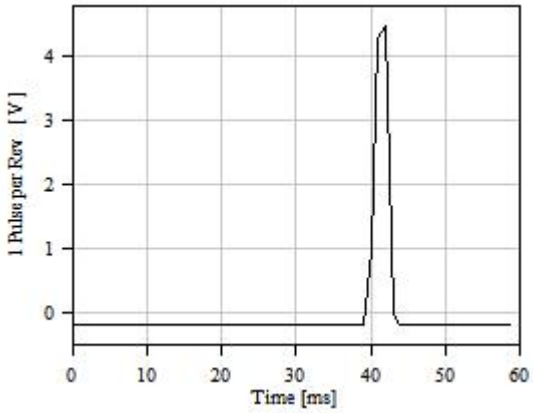
Hall sensor

Signals with digital levels are also possible:



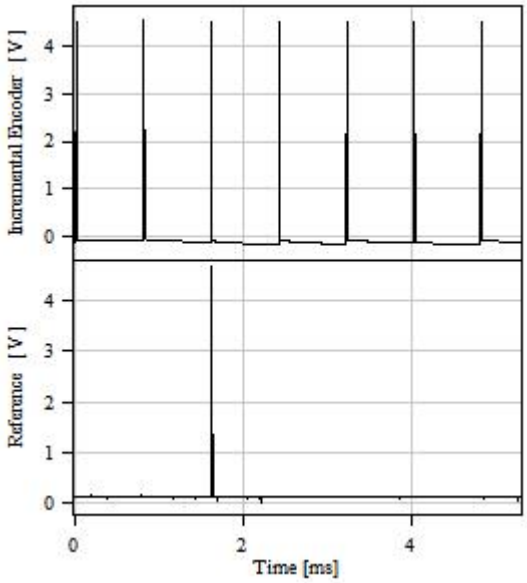
Logic level signal

It is also possible to use a sensor returning only one pulse per crankshaft revolution:



1 pulse per revolution

It is also possible to use an incremental counter having an additional zero output, which is connected to the CANSAS-IGN as the reference signal (REF). The zero output then indicates the crankshaft's zero marker.



Incremental counter with zero output

Precision

CANSAS-IGN captures when the signals cross defined thresholds, at a resolution of fractions of microseconds. From these data it is possible to calculate the ignition angle with precision of 0.1 crankshaft degree and better, even at high RPMs. Thus, if there even is any imprecision, then it is in determining the pulse times. This is mostly because the pulses are not steep enough and a threshold value must be determined. then the threshold selection influences the time when the pulse is detected. Also, the sensor equipment is subject to transit times which vary with the RPMs and cannot be corrected. The sensor equipment itself has some imprecision. For instance, cogwheels may not be manufactured exactly, VRS sensors return RPM-dependent phase shifts. Some of the effects can be compensated by appropriate parameterization of CANSAS-IGN, but some can't.

Snaphot-Mode

To parameterize CANSAS-IGN appropriately, a so-called Snapshot-mode can be configured. In that case, the module takes brief snapshots of the input signal at high data rate in a storage volume. Next, the storage content is read back at a slower data rate via the CAN-Bus. This provides the user with a very good view of the signal's course, making it possible to set sensible levels for recognizing signal edges. But it also becomes possible to check in advance the effects of smoothing filters, AC-circuits, etc..

6.11.1 Interference suppression

- The inputs' electrical insulation prevents interference from adjacent channels to be picked up.
- An anti-aliasing filter of ca. 500 kHz provides some interference suppression.
- Low-pass filters can be parameterized to provide interference suppression.
- Parameterized hysteresis filter suppress noise and interference peaks with a lower level than the hysteresis width.

When pulses follow upon each other rapidly, only the first is taken into consideration. In that case, the maximum RPMs are dtermined and subsequent pulses are ignored if they are nearer than 50 % of the expected regular distance.

Further, with the ignition angle an range of at least ca. 10 degrees (but a maximum of 20 ms) is covered, within which subsequent pulses are ignored. The ignition produces strong oscillations, but only the first edge of the first pulse determines the ignition time, while the many subsequent oscillations no longer do.

6.11.2 Housing

The installation kit includes pre-mounted brackets. These can be unscrewed either completely to be removed, or partially to change their angle. This is to make it possible to fasten the module in the test station area or in a switching cabinet.

6.11.2.1 Grounding bolt

For safe operation according to specifications, the housing must be grounded by means of the grounding bolt. The module's housing is not electrically in contact with the power supply voltage or with the inputs. The grounding bolt ensures adequate grounding. Other regions of the housing are mostly not appropriate for adequate grounding, since the housing has a coat of paint.

6.11.2.2 LEDs

The module comes with an operation status LED using the customary CANSAS LED flashing code 188. The LED is next to the power supply terminal.

It also comes with **three** additional green LEDs which indicate for the three input channels (Sparc, Angle, Ref) whether the signal connected is plausible. The following states can be indicated:

- LED shining continuously: Plausible signal with plausible pulse frequency.
- LED not shining: No signal or a signal whose pulses can no be detected.
- LED flashing very rapidly: A signal with significantly too high pulse sequence has been applied.

The LEDs only roughly reflect the signal state. Please be aware that a rapid transition between states may cause ambiguous LED flashing patterns, for instance if very slow pulses cause the LED to flash briefly. When signals are very erratic, it is best to disregard the LEDs.

6.11.2.3 Display

Thanks to the built-in Display unit, it is possible to read measured values even at a distance of several meters. The Display indicates the momentary ignition angle (in degrees) and the current momentary RPMs. If the measured values are outside of the valid range, the readout displays "---".

6.11.3 Operation modes

6.11.3.1 Default operation type

The ignition angle is stated in degrees before TDC (Top Dead Center). If the angle is positive, then it is *before* TDC. If it is negative, then it is *after* the TDC. The ignition angle is limited to the range -180 degrees .. +180 degrees; narrower (configured) limits can apply.

The RPMs are determined by finding the time for one full revolution. In the process, the rotation speed fluctuations within a revolution, which are typical of combustion engines, are not considered. Instead, the value is stabile and representative.

6.11.3.1.1 Message

In default operation mode, the module cyclically sends messages on the CAN-Bus. The clock rate and the CAN-identifier are software-configurable. The message content for Intel-Byte-syntax:

Signal	Start bit	Start byte	Bit count	Integer	Offset	Scaling factor
Ignition angle	0	0	16	signed	0	0.01 degree / LSB
RPMs	0	2	16	unsigned	0	0.5 RPM / LSB

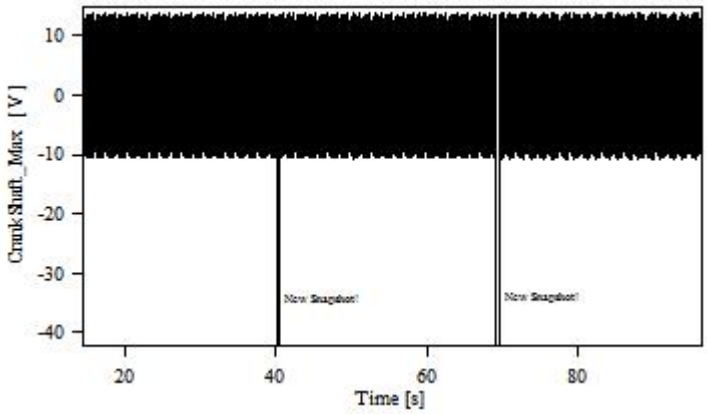
6.11.3.2 Snapshot operation mode

Data recorded at high speed are played back in slow motion. For instance, data written to the internal buffer at 1 MHz and then into the CAN-Bus at 1 ms are shown in a connected CAN measurement device's curve window as a plot at a speed 1000 times slower.

Multiplication factor = Sampling rate_ADC / Output rate_CAN

In the Snapshot mode, there is a short sequence of values outputted on the CAN-Bus once transfer of data from the internal buffer to the CAN-Bus has been completed, which indicates the end of the data. The values on all channels are [-Fullscale]-values, meaning 80H or 800H. These values were not really measured and are not actual signals at the inputs! Following this short sequence, a new snapshot is recorded in the internal buffer and immediately outputted on the CAN-Bus.

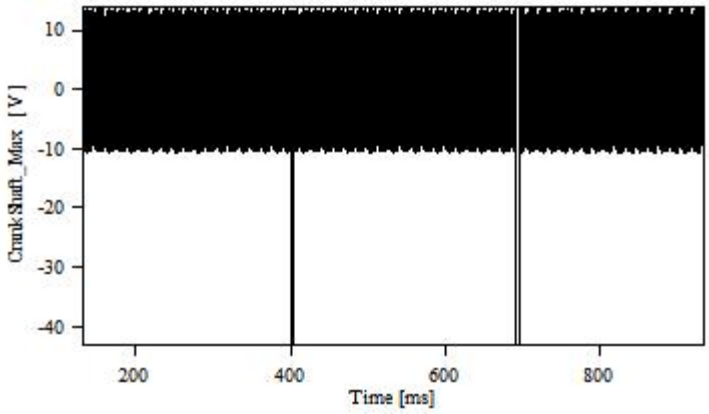
Below is shown a typical Snapshot, illustrating the signal from an engine's own crankshaft sensor (VRS).



Snapshot on the CAN-Bus

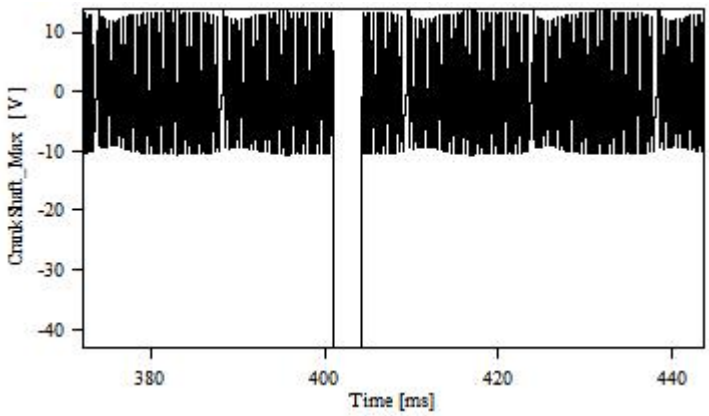
The negative peaks in the recorded CAN-Bus signal, which clearly are not derived from the crankshaft sensor but indicate the start of the next snapshot. In this case, data gathered with a 100 kHz data rate and 30000 points buffer are transferred to the CAN-Bus at 1 kHz. In other words, a snapshot every 30 s.

After correction of the time base, the result is:



Snapshot rescaled

Now it is possible to magnify a segment in order to investigate the cogwheel gap:

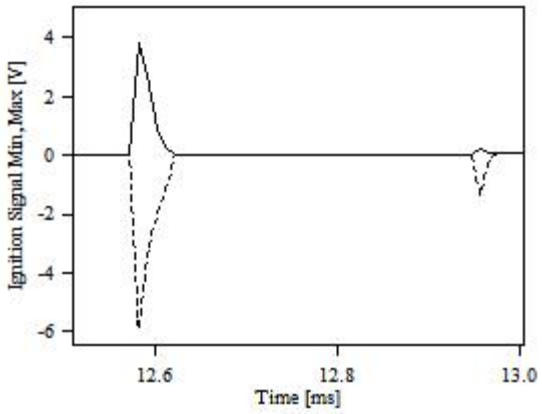


Snapshot zoom

Here is shown a magnified excerpt around the start of a new snapshot. The first valid measurement value is located to the right of the positive edge of -43 V. The cogwheel gaps are clearly seen in the actual signal plot.

For each channel in the snapshot message, there is a minimum and a maximum value. These are needed in order to evaluate the signal correctly, if a different sampling rate than 3 MHz is stated. For example, if 100 kHz is set, the AD converter will still sample at 3 MHz. One each minimum and maximum value is generated from every 30 values. By displaying the Min- and Max-values in a curve window, one sees a "tunnel" through which the actual signal travels. If the tunnel is too wide, then one can assume that (important) signal components are not being displayed and a higher sampling rate should be chosen.

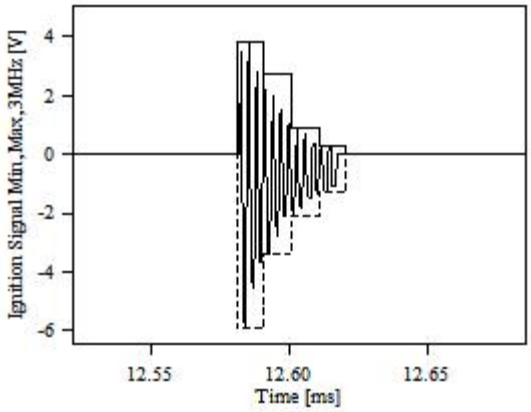
For instance, an ignition signal is sampled at 100 kHz:



Ignition signal with snapshot at 100 kHz

The discrepancy between the Minimum and Maximum is clearly seen. The true course of the signal is between the two envelope lines.

With a 3 MHz clock rate, the oscillation is reflected correctly. The envelope lines Min/Max-plots are displayed as stair-steps, which graphically illustrate the scope of the Min/Max-caluclation.



Ignition signal with snapshot at 3 MHz

6.11.3.2.1 Message

In Snapshot-mode, the module cyclically sends messages on the CAN-Bus. The clock rate and the CAN-identifier are software-configurable. The message content for Intel-Byte-syntax:

Signal	Start bit	Start byte	Bit count	Integer	Offset	Scaling factor
Spark (min)	0	0	12	signed	0	0.0212408 V / LSB
Spark (max)	1	4	12	signed	0	0.0212408 V / LSB
Crankshaft (min)	3	0	12	signed	0	0.0212408 V / LSB
Crankshaft (max)	4	4	12	signed	0	0.0212408 V / LSB
Reference (min)	6	0	8	signed	0	0.342362 V / LSB
Reference (max)	7	0	8	signed	0	0.342362 V / LSB

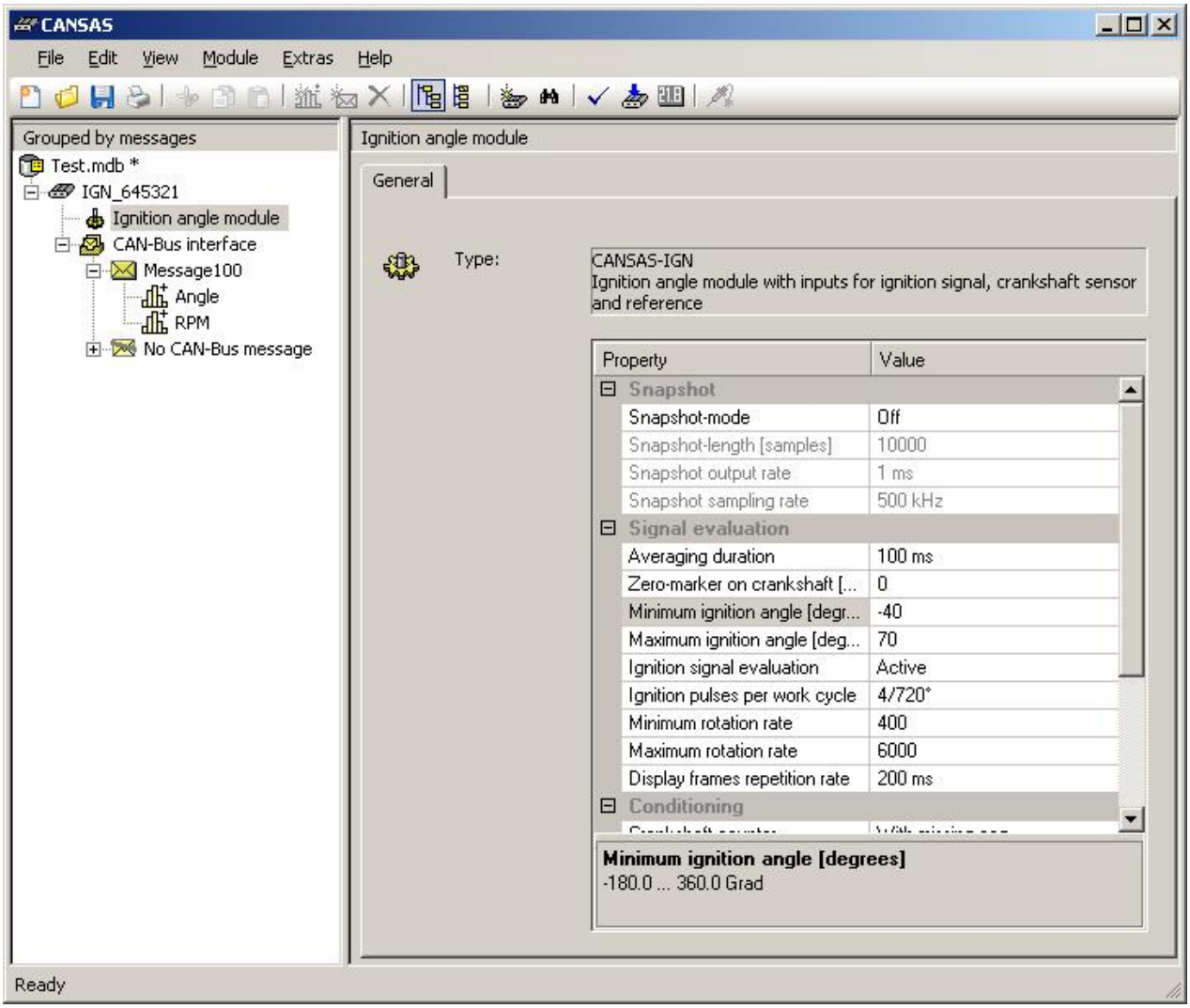
Note

By means of the menu item "*File / Export*...", it is possible to generate a .dbc or .cba file containing the scaling information in the respective mode.

6.11.4 Parameterization

General parameters

If the node "*Ignition angle module*" is selected in a CANSAS-IGN module in the tree diagram on the left side of the CANSAS user interface, then on the right side, a table for setting the module's general parameters appears.



Snapshot-mode:

"*On*": The Snapshot mode can be tuned on/off.

"*Off*": No Snapshot mode. Default operation instead (angle and RPM are determined)

Note: These input channel parameters are also observed in Snapshot mode. For this reason, these parameters must also be well defined:

- switchable pull-up resistor to 5V
- coupling (AC /DC)
- low-pass filter
- absolute value formation

Please also be sure to adjust the CAN-ID correctly.

Snapshot length

Length of Snapshot in samples. Lengths from 1000 to 30000 samples are available. Note that a small buffer leads to fast buffer update rates. E.g. with a Snapshot output rate of 1ms, the complete transfer takes between 1s and 30s.

This parameter can only be edited in Snapshot mode.

Snapshot output rate

After this period, the next CAN message, containing the measurement values of the Snapshots for the next sample is sent. This is the clock rate at which the messages are sent. Periods between 1ms and 10ms are possible. The shortest possible time is recommended in order to transfer the contents of the internal Snapshot buffer as quickly as possible. Naturally, the CAN-Bus' Baud rate must be adequately high.

This parameter can only be edited in Snapshot mode.

Snapshot sampling rate

This is the sampling rate at which the internal AD converter works to transfer measured values to the internal buffer. Sampling rates of 20 kHz up to 3 MHz are possible. Please note that at the highest sampling rates only a very brief signal segment can be captured due to the internal buffer's length limitations.

This parameter can only be edited in Snapshot mode.

Averaging duration

The currently calculated instantaneous values for the ignition angle and the RPM are averaged (arithmetically) over the duration set. Averaging periods of 5ms to 1s are possible. Once the averaging is completes a CAN-message is outputted in which the averaged values are stated. If the display is updated again, the last mean values determined are displayed. As the duration for the averaging increases, the result values become more stable, but the output appears more stagnant. On the analog outputs, as well, the mean values are outputted immediately upon being calculated.

Zero marking on the crankshaft [degrees before TDC]

The angle specified here will be added to the calculated ignition angle. This parameter accounts for the fact that, in general, the zero angle marking on the crankshaft is not at the top dead center (TDC), but a small angle before it. Entered in degrees (-180° to +360°), a positive value indicates degrees *before* TDC, while a negative value indicates a zero mark *after* TDC.

For instance, if the zero mark is +70° before TDC, then enter 70 for this parameter. Conversely, if the zero mark was 120° after TDC, enter -120.

With incremental encoders having a zero pulse, the zero mark is clearly the position where this zero pulse occurs. However, rotational sensors which lack a zero pulse, such as a magnetic pickup on a gear, the zero mark is typically the first tooth (or more precisely, the last edge of the tooth) after the gap. In other words, if the cog signal produces positive pulses, then the first negative signal edge after the missing tooth is the zero mark.

Aside of TDC offsets, this parameter may be used to introduce any general offset into the angle calculation if necessary for user specific conditions or site specific standards.

Minimum, Maximum ignition angles

The expected range for the ignition angle is localized here. For instance, to within a range of

-70 .. + 30 degrees.

This contributes to angles incorrectly calculated due to interference being suppressed already in the device. Thus, the range should be selected to be as narrow as possible.

The range span must be sufficiently small for the number of cylinders. The span is the difference between the maximum and minimum ignition angle. Example: With a 4-cylinder, 4-stroke engine there is an ignition every 180 degrees, namely 4 at equal distances over the complete 720 degree work cycle. If there is an ignition at 170 degrees, then this is 10 degrees before TDC. If there is another ignition at 350 degrees, this is also 10 degrees before TDC. In this case the maximum span for this engine is 180 degrees. For engines with higher cylinder counts, this span becomes less.

Engine	max. span
2 cylinder, 4 stroke	360
3 cylinder, 4 stroke	120
4 cylinder, 4 stroke	180
5 cylinder, 4 stroke	72
6 cylinder, 4 stroke	120
8 cylinder, 4 stroke	90
10 cylinder, 4 stroke	72
12 cylinder, 4 stroke	60

Furthermore, a 3-cylinder engine responds in this regard like a 6-cylinder one in which only every 2nd ignition does not occur.

In no case may the span be exceeded when entering the parameters! Incorrect calculation of the ignition angle would result!

Ignition signal evaluation

If the ignition signal is to be evaluated, this parameter is set to “active”. This is the normal setting.

Only in exceptional cases where the module is used only for determining the RPMs and no ignition signal is connected, this parameter is set to “passive”.

Ignition pulses per work cycle

This is where to set how many ignitions per work cycle. Available for selection: 2/720 degrees ... 12/720 degrees. These are available for 4-stroke engines in which the work cycle is 720 degrees.

This parameter contributes to the ability of not only the first or just one cylinder's ignition pulses to be in the signal but ignition pulses from all cylinders. For instance if a 4-cylinder, 4-stroke engine has ignition at the first cylinder at -10 degrees, and the next ignition at 170 degrees, then KW, then both had ignition at 10 degrees before TDC. CANSAS-IGN uses the specification (in this case 4/720 degrees) in order to convert the 170 degrees to -10 degrees, since it knows from this parameter that there is ignition every 180 degrees.

Minimum, maximum rotation speed

The expected RPM range. RPMs determined to be above the maximum RPM are indicated in the Display with "---". This amounts to overmodulating the input range. The upper limit should therefore be specified with some reserve capacity. For instance, if the engine rotates at up to 6000 RPM, the upper limit may not be set to 6000, since a slight fluctuation (6001 RPM) would already exceed the limit. Instead it would make sense to set the upper limit to 7000. The upper limit may extend up to 20000 RPM. However, it is not advisable to simply set this maximum value, since setting unrealistically high values increases the risk of capturing disturbance pulses. This is because CANSAS-IGN suppresses pulses which are implausibly high, in response to which the corresponding LED flashes rapidly. The best

value for orientation is the highest rotation speed expected.

If the signal falls below the minimum rotation speed during measurement, the system indicates 0 RPM. Therefore, as the minimum to set, a value well below the idling speed is recommended. The lower limit prevents creeping rotation from being indicated but ensures that zero is promptly indicated. The value for the minimum rotation speed's parameter may extend to 100 RPM.

Display refresh rate

This parameter determines at which rate the device's display's picture is refreshed. Rates between 200ms and 1s are possible. It isn't worth having the display refreshed at a higher rate than the averaging duration, since the Display is actually showing averaged values. With more strongly fluctuating signals, a slower refresh rate is recommended in order to make viewing even possible.

Crankshaft sensor

What kind of sensor is connected to the crankshaft in order to obtain information on the crankshaft's angle?

- Sensor with missing cog: E.g. the engine's own sensor on a cogwheel. The cogwheel pattern must be specified separately in the parameter "*Crankshaft cogwheel pattern*".
- Sensor with zero-pulse: Incremental counter whose number of markings is to be specified in the parameter "*Pulse count per crankshaft revolution*". The incremental counter has a zero-output which is to be connected to CANSAS-IGN's signal-output "REF".
- Counter with one pulse per revolution: only one pulse is returned per revolution of the crankshaft.

Crankshaft cogwheel pattern:

For all cogwheels with missing cogs, the cogwheel pattern is selected here.

60-1	1 of 60 cogs missing
60-2	2 adjacent cogs of 60 missing
36-1	1 of 36 cogs missing
36-2	2 adjacent cogs of 36 missing
36+1	1 of 36 cogs is filled in to make one wide cog.
24-1	1 of 24 cogs missing

Pulse count per crankshaft revolution

For all sensors with a zero-output, you can specify how many pulses the sensor returns per crankshaft revolution. The amount of markings or subdivisions of the sensor. May lie between 2 and 3600.

Minimum, maximum crankshaft pulse width

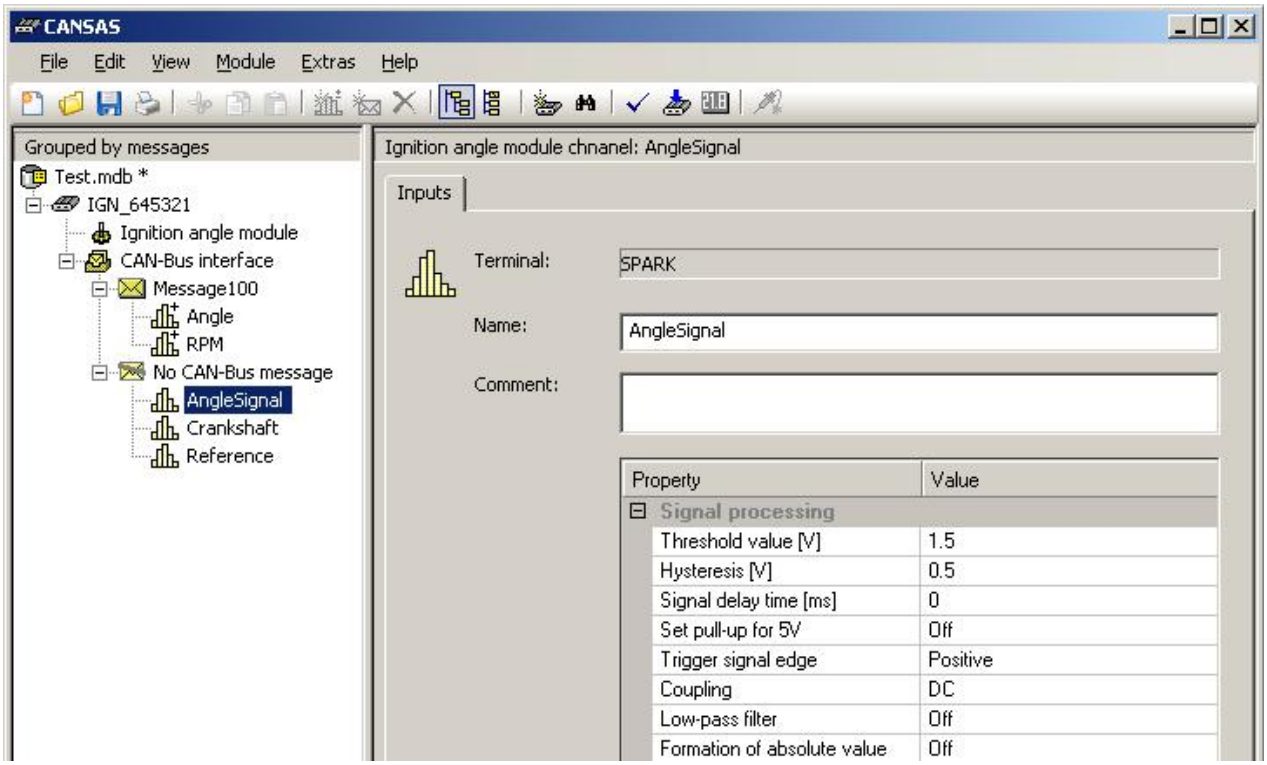
For the crankshaft sensor, the allowed pulse width is specified.

In general, 0 (zero) is specified. The zero indicates that no check is to take place. For instance, if the maximum is zero, it means that there is no maximum pulse width. The pulse may be as wide as desired. If the minimum is zero it means that the pulse may be as narrow as it can.

When working with values other than zero, in other words, when there is to be verification, note that a pulse will be ignored if it is too narrow or too wide. This can in turn only happen if at the moment the signal edge is recognized the pulse width is already available to the device. If one has a positive pulse, then the negative edge must be the edge set for the crankshaft signal. The (short) pulse begins with the positive edge and ends with the negative one. At its end, its duration is known. If the duration is to short or too long, the edge is ignored. If the positive edge is set where there is a positive pulse, then the time between pulses is measured and used as the determining criterion. The positive edge may thus only be used with negative pulses.

6.11.4.1 The channel's parameters

If on the left side of the CANSAS user interface's tree diagram, one of the input channels (ignition signal, crankshaft, reference) in a CANSAS-IGN module is selected, then on the right side a table for setting the input channel parameters appears. Multi-selection of the channels is possible.



Threshold value:

A signal edge is detected when a certain signal level is crossed. This threshold value/level is stated in Volts. It can lie between -40 V and +40 V. A resolution of 0.1V should also not be exceeded. This means that sensible thresholds would include, for instance: 0 V, 0.1 V, 0.2 V, ...

Hysteresis:

In order to prevent that low-level noise in a not very steep edge causes multiple crossings through the threshold value, it is possible to enter a hysteresis here. Only once this hysteresis has been crossed, the edge detector monitors the signal from the other direction. The hysteresis can be stated between 0 V (= no hysteresis) and 40 V.

Signal delay:

If a signal arrives delayed at the edge detector, then it is possible to specify the delay time using this parameter. The time specified here directly affects how the ignition angle is determined, since determining it involves observing the ratios of time differences between various pulses. The signal delays are observed in forming the time differences.

E.g. the following effects can delay a signal:

- the original signal itself is already delayed
- the sensor causes delay
- external conditioning, lines cause delay
- (different) conditioning in CANSAS-IGN can also cause delay, especially low-pass filters!
- a signal's edge is not very steep. The threshold value is in the middle of the edge, not at its start.

Delay times are not always easy to determine. However, an imprecise or incorrectly entered time can cause significant errors in determining the ignition angle.

The delay time is stated in ms, and may not have decimal places. Even microseconds make a difference!

The Snapshot mode can help to determine the delay times, particularly with edges which are not very steep. This is because depending on ow high the threshold value is, there can be a different delay with respect to the actual start of the edge.

Thus, even with low pass filters (e.g. CANSAS-IGN's parameterizable 1st order low-pass) it is not easy to determine the delay time according to the rule of thumb (0.16 / cutoff frequency). This rule of thumb is only valid with a suddenly jumping input signal, for instance, if the threshold value is about 63% of the peak height. If the threshold value is different, the delay can be significantly different. Since the threshold value and the signal shape are relevant, the CANSAS software is not able to automatically correct any delay caused by a configured low-pass filter.

Pull-Up to 5 V:

A resistor can be switched on at each input to 5 V. If this resistor is switched "*ON*", then an external switch (switch to 0 V) can easily be connected. Otherwise, the resistor is not used ("*OFF*").

This parameter is also effective in Snapshot mode.

Trigger edge:

The edge detector determines the threshold crossing only in the specified edge direction: positive or negative.

Coupling:

AC- or DC-coupling can be selected. With AC-coupling, a 1st order high-pass filter is connected between in order to eliminate a DC-offset. With DC-coupling, this high-pass filter is not connected between. The high-pass filtering comes before the optional absolute value formation and thus before the edge detector.

This parameter is also effective in Snapshot mode.

Low-pass filter:

Optionally, a low-pass filter can be set in the parameters in order to smooth the signal and suppress noise. Brief outliers are also reduced. The low-pass filter can be varied between 2 kHz and 100 kHz cutoff frequency. The low-pass is always 1st order and can also be turned off entirely.

Note that in addition to this configurable low-pass, the analog low-pass is also present, which can not be turned off.

If a low-pass filter is used, it is absolutely necessary to adapt the signal delay time accordingly.

The low-pass filter comes after the optional absolute value formation and before the edge detector.

This parameter is also effective in Snapshot mode.

Absolute value formation:

Optionally the absolute value can be formed. This may be of interest for the ignition signal if the ignition sensor can also be connected in a different orientation.

Formation of the absolute value is performed following the optional AC-coupling, but before the optional low-pass filtering and thus before the edge detector.

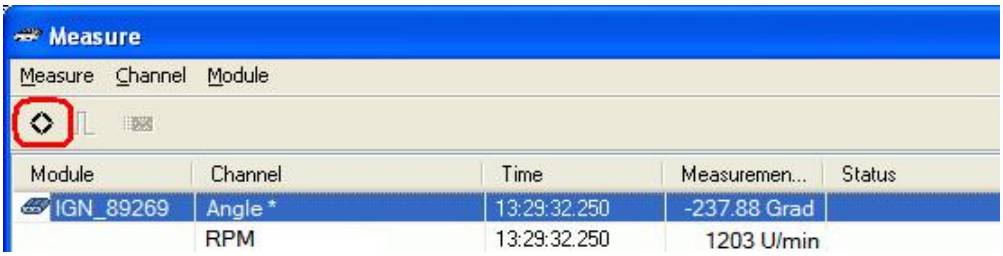
This parameter is also effective in Snapshot mode.

6.11.4.2 Offset adjustment

The offset is adjusted at factory.

It is recommended to have the offset rechecked and adjusted once per year. For this purpose, imc offers maintenance servicing.

The user can also perform the offset adjustment. To do this, one short circuit connector must be connected to each input channel. Subsequently the menu item "*Module / Measure*" is called.



The adjustment button is clicked next.

If adjustment was not successful, there is a readout on the device's display.

Subsequently, a control measurement should be performed in Snapshot mode.

6.11.5 Tips

Rotation speed or ignition angle not readable

The numerical values are only clearly visible to the human eye if the same value remains visible sufficiently long. A display refresh interval of 500ms is recommended in order to be able to even read rapidly changing numerical values.

As well, a longer averaging period can contribute to making the readout more stabile. It is especially helpful to make the averaging period and the display refresh rate match.

If the values do not change as rapidly, it is also possible to set both to 200ms.

Readout of rotation speed shows "---" in the Display

Either no signal or an implausible value, i.e. the currently calculated RPM is higher than the value configured for the parameter *"Maximum rotation rate*". In such a case, the LED for the crankshaft will not necessarily flash rapidly. It only flashes rapidly if the RPM is significantly too high, but not for minor range violations. To perform a test, it is possible to set the parameter "*Maximum rotation rate*" to the highest permitted value 20000, since the RPMs may actually be higher than expected. But later be sure to reset the limit as low as possible for purposes of interference suppression.

If the value calculated is incorrect for the rotation speed, then the number of cogs per revolution can be checked, or the threshold/hysteresis. This is because the module may be detecting too many signal edges.

Ignition angle shows "---" in the display

If the rotation speed is 0 or invalid, ten it is not even possible to calculated a value for the ignition angle. However, if the RPM value is valid, then there is a variety of possible causes. The LED for the ignition signal must shine constant green or else the ignition signal must be checked. The LED for the reference signal must shine constant green if an incremental counter with zero-output is used. If it does not shine constant green, the reference signal should be checked.

If the input signals are in order, then it is worth extending the permitted ignition angle range as a test: temporarily set a lower value for the *"Minimum ignition angle*". The value should be as low as possible (see table for the description of the parameters Minimum, Maximum ignition angles). For instance, if measuring a 4-cylinder 4-stroke engine, the difference between the two may be 180 degrees. So, if the maximum value is set to 70 degrees, the minimum may be set to -110 degrees. For interpreting the values, note that all angles measured are brought to the range -110..+70 degrees by adding or subtracting multiples of 180 degrees. Thus, if 77 degrees were measured, then 77-180 degrees = -10 degrees are shown. You must take this ambiguity into account.

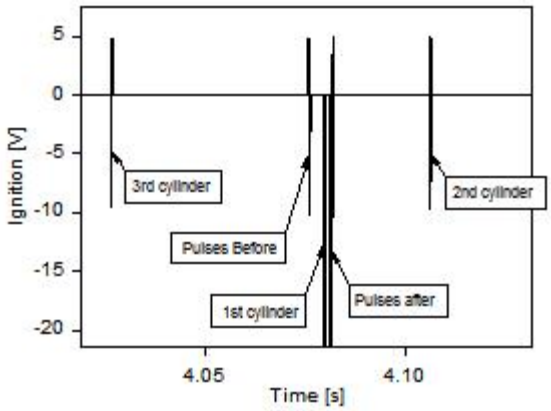
The value for the crankshaft's zero-marking can be checked. An incorrect value there leads to an offset of the angle display.

Ignition angle shows random numbers

The display of the ignition angle is not stable but shows apparently random numbers. If at the same time the RPM is incorrect, then the RPM should first be checked. If the RPM is correct and stabile, then the number of *"Ignition pulses per work cycle"* should be checked. Further, the settings for the threshold value and the hysteresis of the ignition signal should be checked. When working with an incremental counter having a zero-output, also check the reference signal.

If no Logic Level Signal is provided by the control electronics for capturing the ignition time, but it is instead captured by a clamp ignition sensor, then the pre-conditioning of the signals as well as the threshold value and hysteresis must be given special attention.

Example:



3-cylinder ignition signal

The ignition clamp sensor is connected in such a way that it surrounds the 1st cylinder's ignition line. The other cylinders' signals however are coupled in, as well as the pulses before and after the actual ignition.

The conditioning must now be parameterized in such a way that the 1st cylinder's pulse is captured in all cases. It doesn't matter if the other cylinders' pulses are also captured. Since in this case 3 "*Ignition pulses per work cycle"* was set, the device knows that the ignition pulses are 240 degrees apart. So, if for instance the 2nd cylinder's ignition pulse is captured, then 240 degrees are subtracted from its angle.

The interference pulses directly after the ignition pulse ("pulses after") are no problem either. The CANSAS-IGN hardware suppresses pulses which do not closely follow another one.

What is critical is suppression of pulses BEFORE the actual ignition pulse ("pulses before"). If the edge detector recognizes these pulses as valid pulses, then this point in time is assumed to be the ignition time, so that in consequence incorrect ignition angles are determined. By means of low-pass filtering and a suitably large hysteresis, it is possible to compensate for these pulses before the ignition time. One interesting possibility is offered by forming the absolute value plus subsequent low-pass filtering. By this means, isolated fluctuations will lead to a tiny "hill", while a package of multiple fluctuations results in a large "hill" where a threshold is easy to set.

It is worth being cautious about too much smoothing, which might cause the actual ignition pulse to appear too weak, so that the "pulses after" dominate and are the only ones recognized. This, too, would lead to the ignition time being determined incorrectly.

In any case, with such signals it is worth checking whether the sensor can be set to a better position.

6.11.6 IGN terminal

6.11.6.1 Inputs (BNC)

3 isolated BNC sockets for 3 isolated input channels:

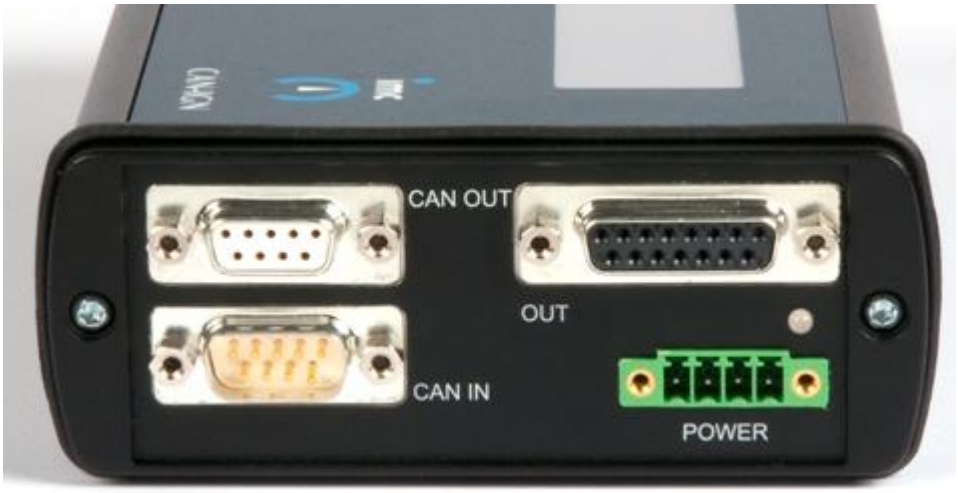
CANSAS-IGN: BNC inputs

- SPARC: connector for the ignition signal
- ANGLE: connector for the crankshaft sensor
- REF: If an incremental counter is used as the crankshaft sensor, the counter's zero-output is connected here.

Uniform conditioning is provided for all 3 signals: voltage isolation, bandwidth approx. 600 kHz, 40 V input range.

6.11.6.2 Outputs (DSUB9)

This terminal provides the analog and digital outputs and auxiliary power supply. The outputs and power supply are not isolated against the module's power supply.



CANSS-IGN: CAN-connector and analog/digital outputs

Pin	Signal	Reference
1	TTL1 (Spark)	Pin 2
2	Digital Ground 0 V	
3	+12 V (max. 100 mA)	Pin 11
4	DAC1 AngleOut (ignition angle)	Pin 5
5	Analog Ground 0 V	
6	not connected	
7	not connected	
8	not connected	
9	TTL2 Crankshaft	Pin 2
10	+5 V (max. 200 mA)	Pin 2
11	Digital Ground 0 V	
12	DAC2 SpeedOut (RPMs)	Pin 5

The analog outputs AngleOut and SpeedOut return voltage signals which are proportional to the ignition angle and the rotation speed, respectively.

Scaling of the analog outputs:

Signal	Output voltage	..corresponding to	Remarks
AngleOut	-10 V to +10 V	-100 to +100 degrees	substitute value: -10 V, if the ignition angle can not be determined (currently).
SpeedOut	0 V to +10 V	0 to 10000 RPM	substitute value: 0 V, if the ignition angle can not be determined (currently).

The voltages at the analog outputs must be captured differentially, where the reference is Analog Ground = Pin 5.

The power supply voltages (5 V and 12 V) are provided for the supply of sensors. For the negative pole, Pin2 = Digital Ground is used.

The TTL-outputs (Spark and Crankshaft) transfer pulses arriving at the inputs Spark and Angle with a slight delay to TTL-level. So, as reference use Pin2 = Digital Ground.

6.12 INC4 incremental encoder channels

4 inputs for incremental encoders

Parameter	Value (typ. / max)	Remarks
Inputs	4 + 1 (9 tracks)	4 channels with 2 tracks each (X, Y) 1 index-channel, all fully conditioned inputs isolated to CAN-bus and power supply, not mutually
Measurement modes	displacement, angle, events, time, frequency; velocity, RPM	

Beside working with CAN-bus per default, the INC4 is also configurable as **CANopen**® module.

The **analog bandwidth** (without low-pass filtering) of the isolated voltage channels is 500 kHz.

In preparation: The INC4 module supports **TEDS** to read and write sensor information. (modules with mainboard 2)

Technical data INC4. 401

6.12.1 Measurement quantities

The following operating modes can be set separately for each of the 4 channels:

event counting:	**time measurements**:	**combination of counting and time measurements**:
• Events (differential) • Events (cumulative) • Displacement (differential) • Displacement (cumulative) • Angle (differential) • Angle (cumulative)	• Time measurement • PWM	• Frequency • Rpm • Velocity

A detailed description of incremental encoder data acquisition is found in Chapter "Measurement technique". 164

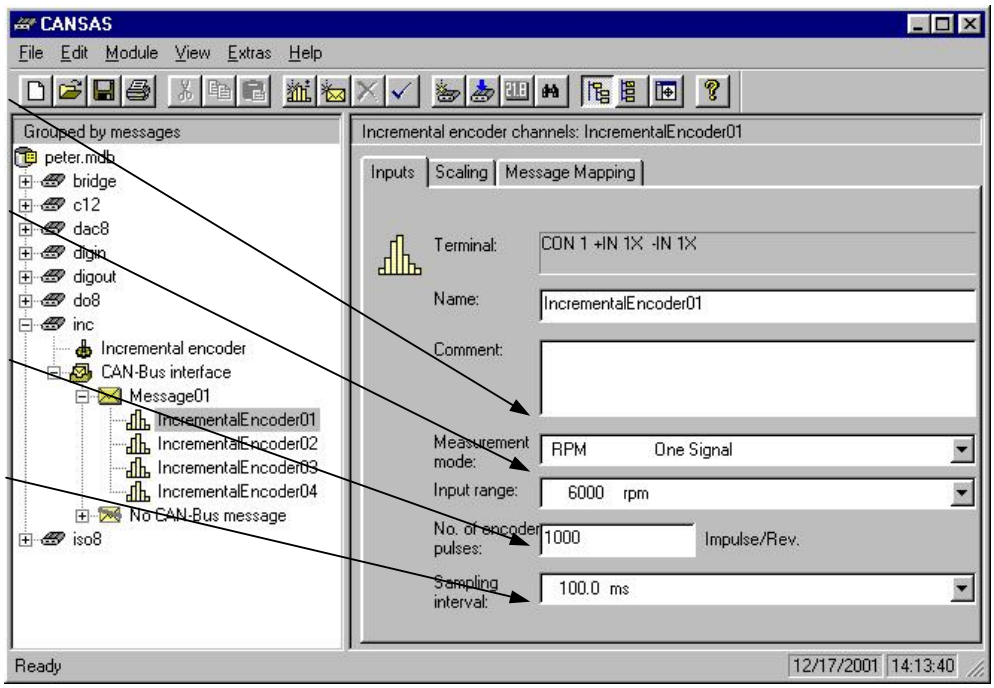
Setting the operating mode: *IncrementalEncoder0x → Index card “Inputs” → Combo box “Measurement mode”*

Combobox for selecting measurement modes

Combobox for selecting input range

Input box for setting number of encoder pulses

Combobox for setting sampling interval



The **sampling interval** determines at what rate result values are returned (or internally: at what intervals the counter findings are evaluated).

Setting the sampling interval:
IncrementalEncoder0x → Index card "Inputs" → Combo box "Sampling interval"

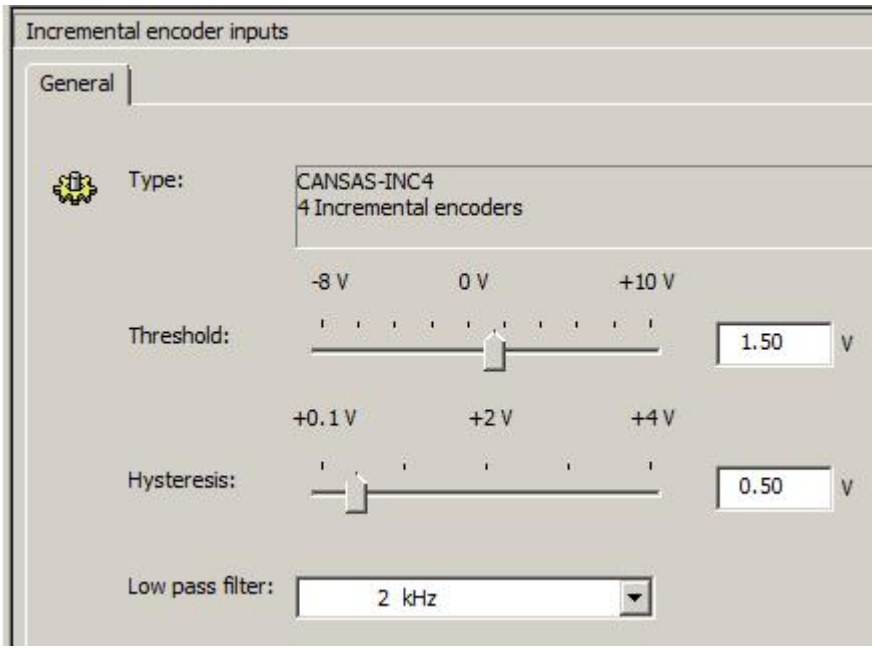
The available selections are:

1 ms	10 ms	100 ms	1 s	10 s	1 min
2 ms	20 ms	200 ms	2 s	20 s	
5 ms	50 ms	500 ms	5 s	30 s	

6.12.2 Comparator configuration

Setting the switching threshold:
Incremental encoder → Index card "General" → Input box "Switching threshold"
Setting the hysteresis:
Incremental encoder → Index card "General" → Input box "Hysteresis"
Setting the input low pass filter:
Incremental encoder → Index card "General" → Combo box "Low pass filter"

Setting the switching threshold or hysteresis can be accomplished either using the sliding button or the input box to the right of the sliding button:



The conditioning set is valid for all 4 incremental encoder channels, as well as for the index-channel (zero impulse). The only exception is that the index channel has a fixed frequency filter (20 kHz).

- Note on setting the threshold:
  Note that the input voltage range is only -8 V..+10 V. Thus, a threshold of +10 V is possible, but not recommendable. To avoid overloading the input amplifier (from which it can only recover slowly), a divider should be connected for high input voltages.
- Note on setting the hysteresis below 300 mV (out of specification):
  Setting the hysteresis below 300 mV is possible, but it is not recommended unless the input signal amplitude is below 1 V in all active incremental counter channels of a module. Lower hysteresis settings combined with larger input signals may result in an input signal falsely registering in more than one channel.

6.12.3 Sensor types, synchronization

Zero impulse (Index signal) denotes the synchronization signal *SYNC* which is globally available to all four channels in common. If measurement mode with Zero impulse channel has been selected (e.g. Angle (diff) One Signal & Zero impulse), the following conditions apply: After the start of a measurement the counters remain inactive until the **first *positive slope*** arrives at **+INDEX**. This arrangement is independent of the release-status of the Start-trigger condition.

☞ **Note**

- The pins for the zero impulse (index) is connected to CON1 only!

The zero impulse is only considered after configuring or reboot of the CANSAS INC4. A restart of the measurement without restart of the CANSAS does not reset the index channel!

Incremental encoder sensors often have an **index track** (index signal, zero marker pulse) which emits a synchronization-signal once per revolution. The SYNC-input is differential and set by the comparator settings. Its bandwidth is limited to 20 kHz by a permanently low-pass filter. If the input remains open, an (inactive) HIGH-state will set in.

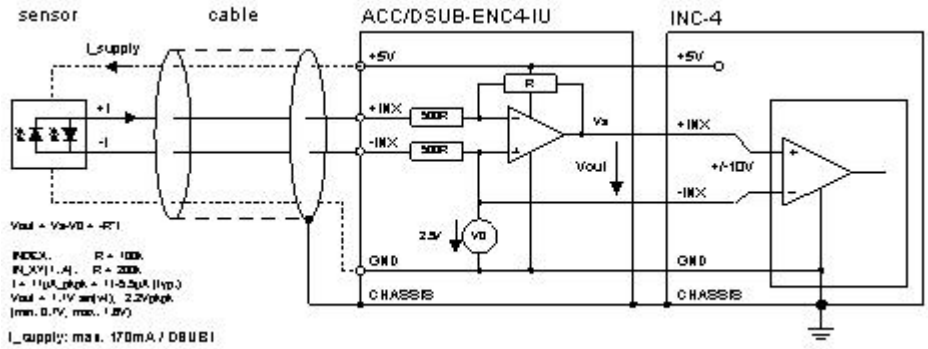
The measurement types Linear Motion, Angle, RPM and Velocity are especially well adapted for direct connection to **incremental encoder-sensors**. These consist of a rotating disk with fine gradation in conjunction with optical scanning and possibly also with electric signal conditioning.

One differentiates between single track and dual track encoders. Dual track encoders (quadrature encoders) emit two signals offset by 90° of phase, the tracks A and B (C and D). By evaluating the phase information between the A and B-track, the direction of turning can be determined. If the corresponding encoder type is selected, this functionality is supported.

The actual time or frequency information, however, is derived exclusively from the A(C) -track!

The measurement types Event, Frequency, and Time always are measured by **one-track encoders**, since in these cases no evaluation of direction or sign would make any sense. The sensor must simply be connected to the terminal for Track A (C).

6.12.4 Sensors with current signals



For a rotational encoder working with current signals, the current/ voltage terminal ACC/DSUB-ENC4-IU can be used. It is possible to power the sensor from the INC4 module. The pertinent specifications are: max. supply current: 170 mA per DSUB-terminal. Higher supply current should be provided externally.

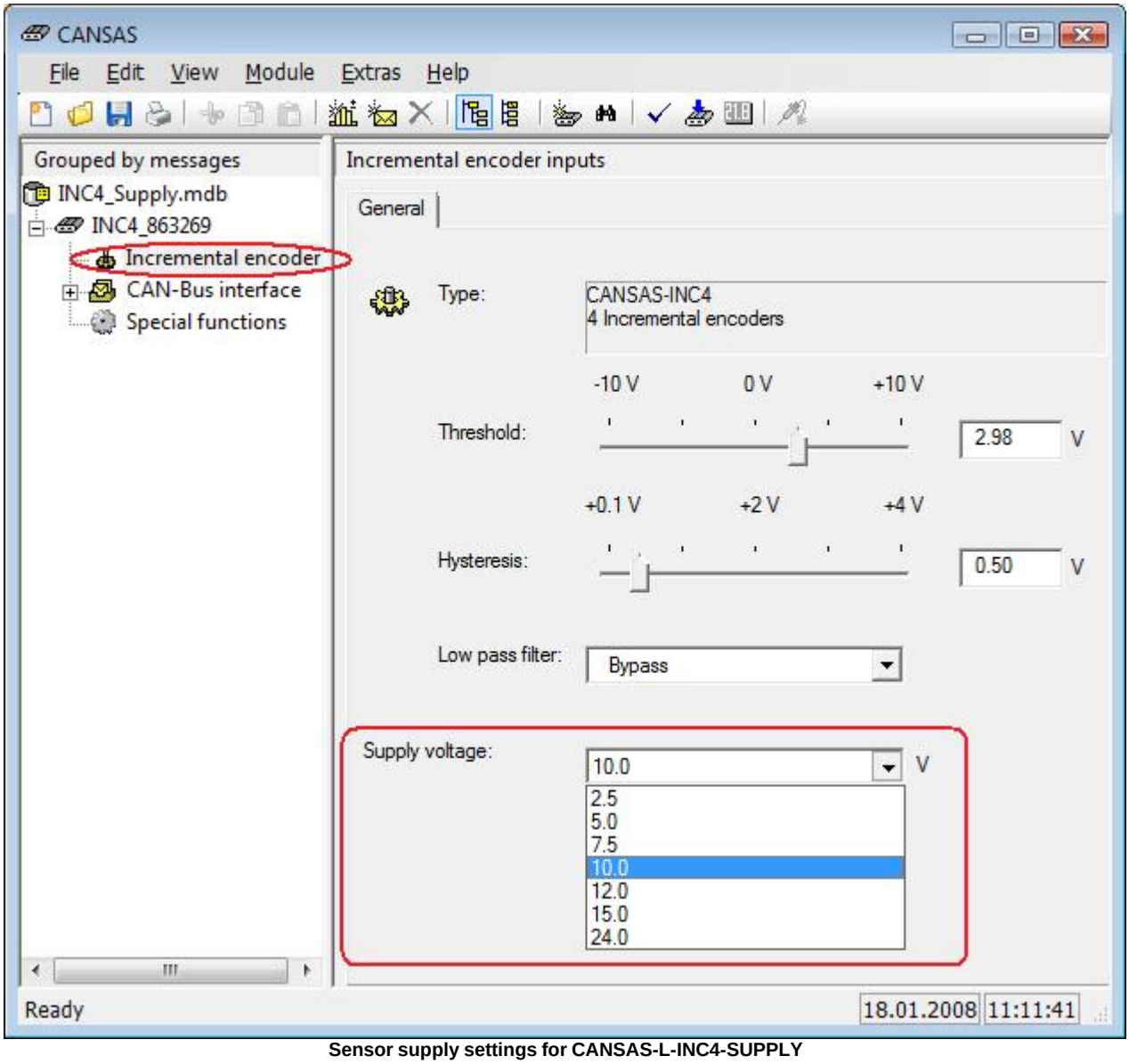
typ. encoder with 11µAss signals: Heidenhain ROD 456, current c: max. 85 mA per (2-signal) encoder

→ insufficient module supply! Sensor must be supplied externally!

6.12.5 Sensor supply at L-INC4-V-SUPPLY

The module CANSAS-L-INC4-V-SUPPLY is equipped with a sensor supply module 427.

The sensor supply is connected via the pins C (+SUPPLY) and D (-SUPPLY) at the ITT VEAM connector. The supply voltage is set by the software.



Sensor supply settings for CANSAS-L-INC4-SUPPLY

6.12.6 Connector plugs

For the pin assignment of the DSUB-15 plugs see here. 444

Pin configuration of CANSAS-L-INC-V and CANSAS-L-INC4-V-SUPPLY with ITT VEAM terminals. 454

Pin configuration of CANSAS-SL-INC4-L with LEMO terminals. 456

Pin configuration of the CANSAS-K-INC4 with DSUB-9 454.

6.13 ISO8 isolated voltage channels with current and temp. modes

8 differential, analog inputs

Parameter	Value (typ. / max)	Remarks
Inputs	8	4 channels on each DSUB-15 socket
Measurement modes CAN/ISO8, CAN/ K-ISO8	voltage voltage with divider current thermocouples Pt100	configurable in blocks of 4 standard-plug (CAN/DSUB-U6) divider-plug (CAN/DSUB-U6D) shunt-plug (CAN/DSUB-I6) thermo-plug (CAN/DSUB-T6) Pt100-plug (CAN/DSUB-PT): 4 channels with contacts for 4-wire connection or voltage plug (CAN/DSUB-U) 6 channels without contacts for 4-wire connection.
CAN/ K-ISO8-BNC	voltage with divider	BNC
CAN/ K-ISO8-2T CAN/ K-ISO8-3T	thermocouples	TK-connector 2 pol. IEC 584 (green) TK-connector 3 pol. IEC 584 (green)

Technical data ISO8. 403

The CANSAS ISO8 module comes with 8 isolated input channels, which can carry your choice of ***voltage, current, Pt100*** or any DIN-conforming ***thermocouples'*** signals. However, it is only possible to measure with multiple thermocouples at the same time if they are all of the same type. The input ranges correspond to those of the CANSAS C12 module.

A variety of different ***housing models*** are available. The CAN/ISO8 and CAN/K-ISO8 models work in the same manner and only differ in their housing shape. CAN/ISO8 comes in the standard CANSAS housing while CAN/K-ISO8 comes in the cassette housing and also uses 15-pin DSUB plugs.

Other cassette models are distinguished by special terminals on the front panel. The CAN/K-ISO8-BNC model is for voltage measurement with BNC sockets. The CAN/ K-ISO8-2T and CAN/ K-ISO8-3T models allow direct connection of thermoplugs having two or three pins.

The input channels of this module are arranged in two ***groups of four channels***. All channels within a group take the same connector type. Group 1 comprises Channels 1 through 4 and Group 2 comprises Channels 5 through 8.

Otherwise, settings are made analogously to the CANSAS C12 module.
The maximum isolation voltage of ±100 V between the channels pertains to *any two* input pins marked (+) and (-).Measurement with Pt100-units represents a special case:

All of a plug's connected Pt100 sensors are fed by a common reference current supply, so that there is no potential isolation between the individual channels.

The cancellation of the potential isolation even affects ***both input plugs***:
The Pt100-channels of the one plug (Plug1) cyclically assume the potential of the channels at Plug 2!
Also, the entire cabling for the Pt100 channels amounts to a dynamic capacitive load at Plug 2's inputs.

For this reason, ***mixed operation*** consisting of Pt100-measurements on one plug and current/voltage measurement on the other is not advised.
Voltages in ranges >2 V are connected at the so-called Divider plug (CAN/DSUB-U4D).

For current measurements, a plug with shunt resistors is available (CAN/DSUB-I4).

For temperature measurement, the special Thermo-plug (CAN/DSUB-T4) is available. It comes with built-in cold junction compensation.

A specially Pt100 plug is also available (CAN/DSUB-Pt100), which enables the direct connection of Pt100 resistors in 4-wire configuration and which comes with a built-in reference circuit.

6.13.1 Connector plugs ISO8

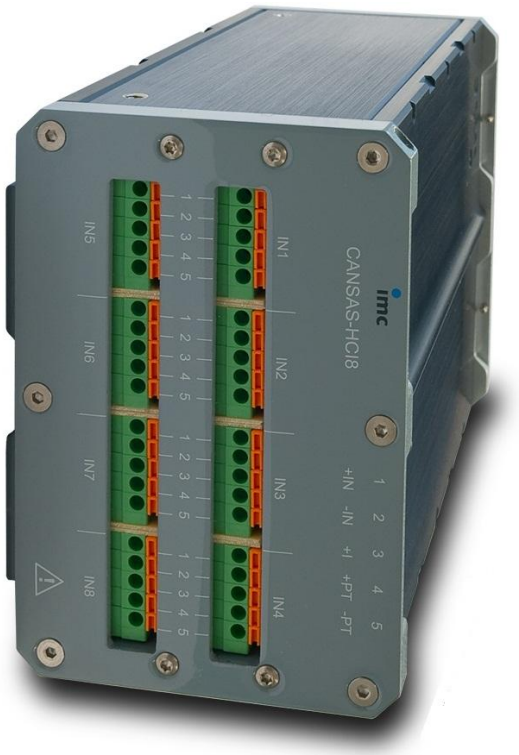
For the pin assignment of the DSUB-15 plugs see here 444.

Connections to CANSAS-K-ISO8-BNC are made with BNC sockets. *CANSAS-K-ISO8-T2* and *CANSAS-K-ISO8-T3* come with two- or three-pin TK-sockets.

6.14 HCI8 isolated voltage, current, resistor, temperature

8 isolated, differential analog inputs with high common mode voltage

Parameter	Value	Remarks
Measurement modes	voltage current resistor thermocouples, RTD (Pt100)	all measurement modes individually isolated

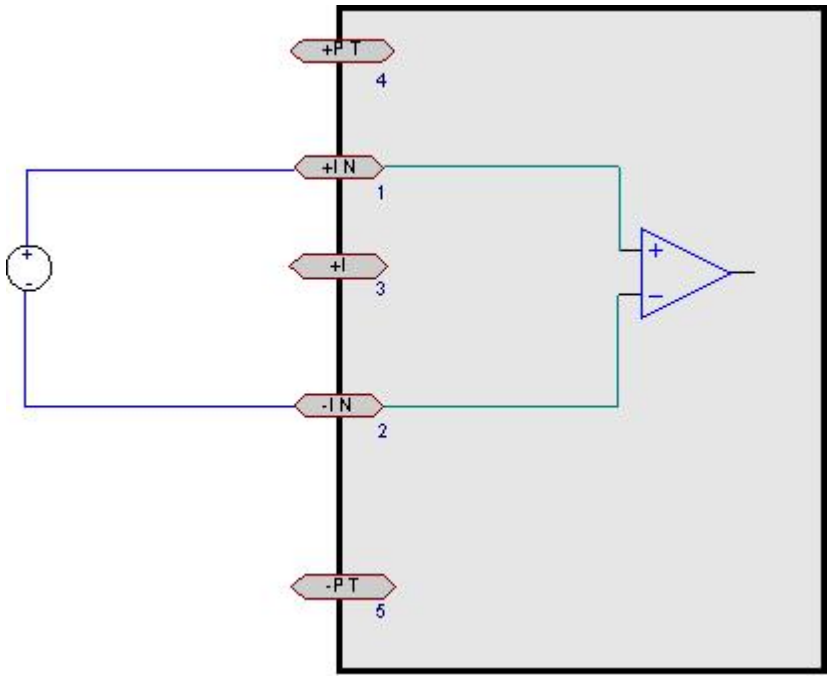


CANSAS-HCI8, by means of its 8 isolated channels, enables the measurement of: voltage, current, resistance and temperature. This amplifier's **special** strengths are:

- isolated measurement of low voltages, resistor, current and temperature (thermocouples and Pt100) on a high common mode level
- differential: max. 60 V measurement range / 600 V overvoltage protection at 800 V common mode isolation
- high signal bandwidth
- **typical applications** for the module include on board hybrid vehicles and measurements of battery and fuel cells etc.
- It supports the **CANopen**® protocol according "*CiA® DS 301 V4.0.2*" and "*CiA® DS 404V1.2*"; 4 TPDO (Transmit Process Data Objects) in INT16, INT32, and FLOAT. The supported capabilities, more standards and the settings which can be edited via CANopen® are described in *"CANSAS CANopen®"* . CANopen® mode does not support virtual channels and controlling the LEDs.

The technical specs of the HCI8 405.

6.14.1 Voltage measurement

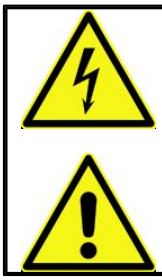


configuration for voltage measurement

- Voltage:
  ±20 mV to ±60 V

The differential input impedance is 6,7 MΩ in ranges up to ±2 V. For all other ranges and if the device is de-activated, the impedance is always 1 MΩ.

The inputs are DC-coupled. The differential response is achieved by means of the isolated circuiting.



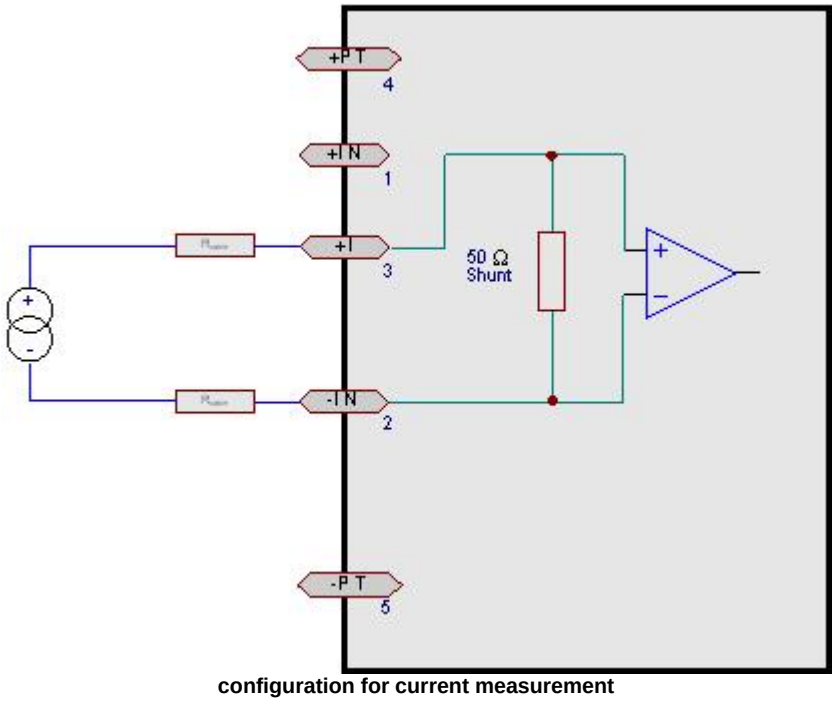
WARNING! Do not damage the safety seal!

Each high-voltage module of your CANSAS-HCI8 unit was inspected for compliance with the safety guidelines per DIN EN 61010-1 prior to delivery, and subjected to a high-voltage test. The module is sealed after having passed these final tests.

If the safety seal is damaged, safe work cannot be ensured.

Any intervention, for instance temporary removal of the module, makes re-inspection for safety.

6.14.2 Current measurement



configuration for current measurement

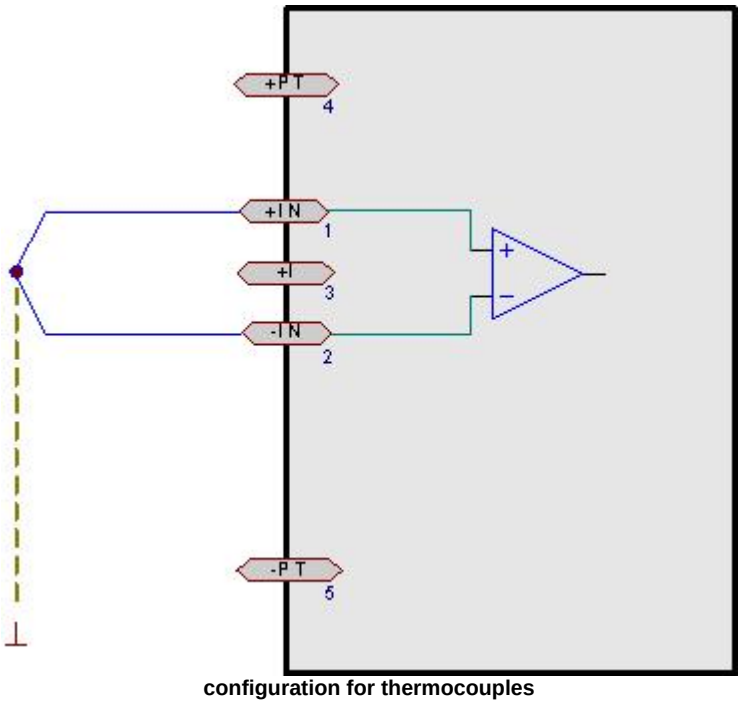
- Current: ±20 mA, ±10 mA

The current measurement is connected via an internal 50 Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN.

6.14.3 Temperature measurement

The input channels are designed for direct connection of ***thermocouples and PT100***-sensors (RTD, platinum-resistance thermometers according DIN and IEC 751). For a detailed description of temperature measurement, go .

6.14.3.1 Thermocouple measurement



configuration for thermocouples

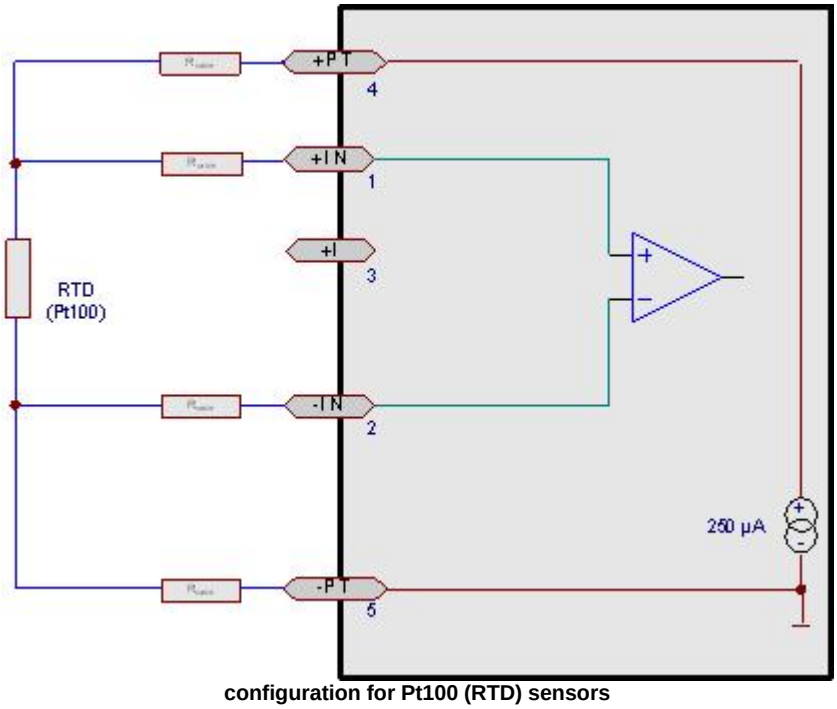
- Temperature ranges:
  -270°C to +1370°C
  -50°C to +400°C
  -50°C to +150°C

Thermocouples: type R, S, B, J, T, E, K, L, N according IEC 584

Note

The channel terminals are at different distances from the cold junction. Internally, this is taken into account by means of gradients. Note that the physical location is important. The precision stated in the technical specs applies for installation location in a thermally stabilized environment.

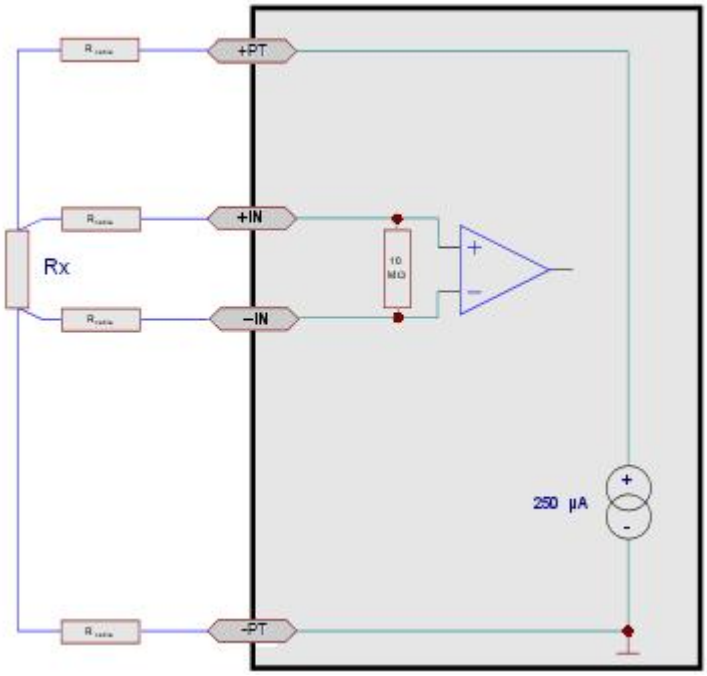
6.14.3.2 Pt100 (RTD) - Measurement



configuration for Pt100 (RTD) sensors

measurement range:
-200°C to +850°C
-50°C to +150°C

6.14.4 Resistance measurement



configuration for resistor measurement

- Measurement ranges:
  - 0 Ω to 1000 Ω
  - 0 Ω to 500 Ω
  - 0 Ω to 250 Ω
  - 0 Ω to 150 Ω

Each resistor is fed by a separate current source with approx. 250 µA. The measurement uses 4-wire configuration.

The resistor is supplied by 2 lines (+I, -I). The other two measurement inputs (+IN, -IN) serve as Sense-leads. By using the Sense-leads, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

Probe-breakage recognition:

The indicated measurement value changes to zero if the connection between I+ and IN+ is broken. If only the connection to the resistor at IN+ is broken, the indicated value is the input range end value.

6.14.5 Bandwidth

The channels' **max. sampling rate** is 1 kHz (1 ms). The **analog bandwidth** is 440 Hz (-3dB).

6.14.6 Connection

- connection via PHOENIX spring-clasp terminals, 5 contacts/channel

pin configuration for each input IN1 to IN8

PIN	Signal
1	+ IN
2	- IN
3	+ I
4	+ PT
5	- PT

PHOENIX FFKDS 3,81

☞ **Note**

There is a possibility for certain function configurations to cause an electrostatic discharge (ESD) directly at the connection terminals. This can lead to asynchronous operation (crash) of the CANSAS-HCI8. This will not cause any damage.

A brief interruption of the power supply causes the module to restart (correctly).

This unintended instance of ESD is practically only possible if a person carrying static charge touches one of the measurement inputs during measurement. If there is any need for such contact, the risk of ESD can be avoided by previously touching the device's metal housing.

6.15 P8 pressure

8 pressure measurement inputs

Parameter	Value (typ. / max)	Remarks
Inputs	8	Plus internal barometer for calculations
Measurement modes	pressure, absolute pressure, relative	

The CANSAS pressure module is offered in two housing varieties, CANSAS–L–P8, CANSAS-K-P8 and CANSAS–IP65–P8, and can measure either absolute pressure or in relation to ambient pressure.
Technical data P8. 408

CANSAS-L-P8

CANSAS-P8-IP65

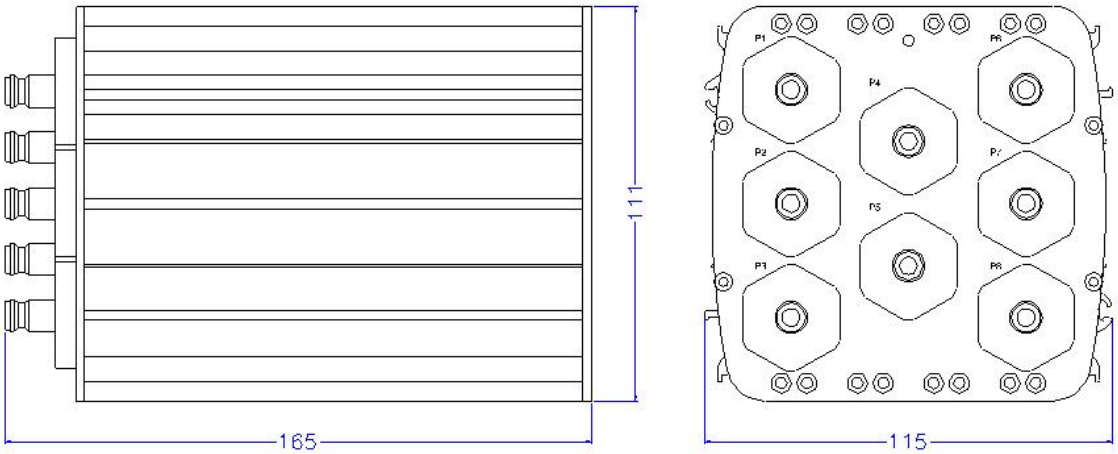


Figure 1:CANSAS-L-P8: preferred mounting position

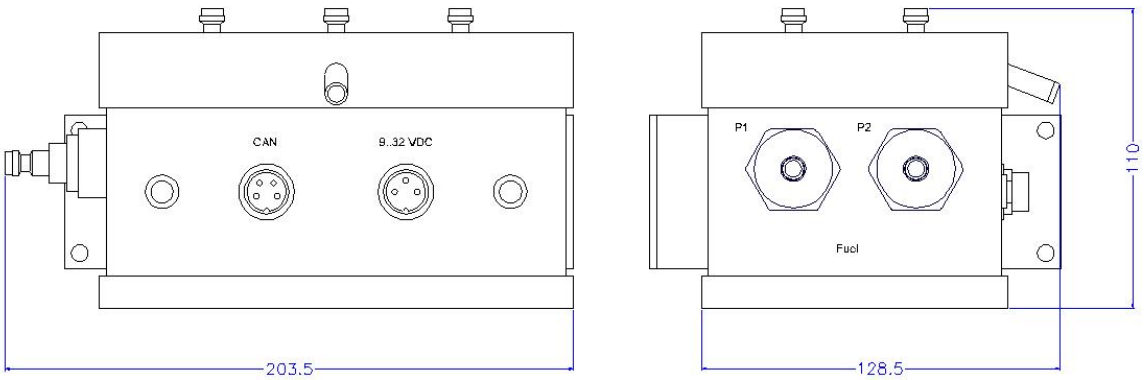


Figure 2:CANSAS-IP65-P8: preferred mounting position

6.15.1 General remarks

The pressure module P8 contains 8 pressure sensors built into attachment nipples. Using an appropriate coupling, tubes carrying gases or fluids whose pressure is to be measured can be connected at the nipples. In the module's interior is an additional pressure sensor which serves as a barometer and constantly measures the ambient air pressure.

6.15.2 Absolute and relative pressure

The 8 inputs have a fixed combination of sensors which depends on the model of the P8-module.

Absolute pressure sensors measure absolute pressure. A typical input range is 0..10bar. Absolute pressure can never be less than 0bar, since 0bar is already a vacuum. If no medium is connected to a nipple with a built-in absolute pressure sensor, then that sensor will measure the ambient air pressure. You would then obtain measurement values around 1bar.

Relative pressure sensors measure pressure in relationship to the ambient air pressure. In this case, one side of the sensor's membrane has contact to the medium to be measured, and to the surrounding air on the other side. Depending on which side presses harder, the membrane is bent toward one side. Thus relative pressure can be either positive or negative . Input ranges of ±300 mbar are typical. If nothing is connected to the nipples, they deliver measurements of around 0mbar. The measurement value is positive if the pressure of the medium is higher than the atmospheric pressure.

6.15.3 Barometer

The barometer inside the module can be used to obtain a measurement of relative pressure using the absolute pressure sensor. The module itself refers to the built-in barometer and takes the difference. Use the software to select the measurement type for each channel separately, which is equipped with an absolute pressure sensor. A sensor with the input range 0...10 bar then can produce a relative pressure input range of 1 bar..+9 bar, in other words, shifted down by 1 bar.

The built-in barometer requires permanent contact to the surrounding air. For this purpose, all housing models come either with air-inlets or in the case of the IP65-housing, Goretex (R) membranes.

6.15.4 Sensors

The pressure module is equipped with high-performance sensor which enable precise pressure measurement. Each sensor is calibrated individually by means of a characteristic curve array over the entire temperature range. Thus the typical non-linear behavior of pressure sensors is compensated.

A little EPROM on each pressure sensor records its characteristic data (incl. its characteristic curve array). The sensor and EPROM are to be seen as an inseparable unit which complies with the standard IEEE1451. This means that the module is especially servicing-friendly. The sensor's characteristic data can be queried via the operating software.

The sensors are rather robust and can withstand pressures higher than the input range; refer to the spec sheet for details on limit values. The pressure must not exceed the indicated limits, otherwise the membrane may sustain permanent damage.

Note also in this context that there is a minimum pressure for absolute pressure sensors. Even though the input range is generally given as starting at 0bar (e.g. 0...10bar), the pressure may not fall below the minimum stated in the spec sheet. The sensors are not designed for measurement in near-vacuum conditions. Violating the sensor's minimum pressure requirement can also lead to permanent damage.

The sensor is designed for a particular temperature range which must also not be violated; see the spec sheet. The spec sheet also specifies a maximum temperature for the medium measured. The medium may, indeed, (occasionally) be hotter than the sensor, but if the sensor gets too hot, its accuracy is diminished. In particular, the characteristic curve array for correction of the temperature-dependency is gauged for 85°C.

6.15.5 Factors affecting pressure measurement

Precise pressure measurement requires observance of and compliance with certain constraints.

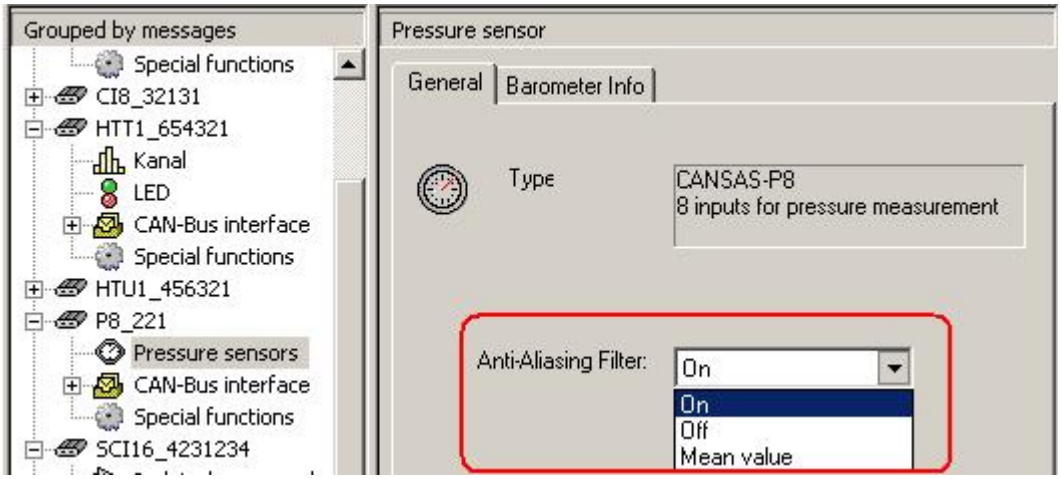
1. **Position-dependence:** The measured value returned depends on how the sensor is positioned when in use. For this reason, observe the "preferred mounting position". This is the position in which the sensors are calibrated at the factory. The sensors' high sensitivity can lead to offset errors when the position is changed, due to the effect of gravity upon the sensor's own oil column. It is important to compensate for this offset, especially for measurements of relative pressure around zero. This can be accomplished using the operating software.
2. **Frequency response:** The sensors' natural frequency is higher than the maximum measurable frequency of 500 Hz. However, the frequency response of the signal connected to the CAN-bus is not only determined by the sensor's frequency response but also by the anti-aliasing filter in the pressure module's electrical portion.
3. **Motion:** If the module is moved, the forces acting on it (e.g. inertia operating on the medium to measure or the membrane itself) can cause measurement distortion. Not that the pressure module responds sensitively to pressure on the membrane, but that these forces can be caused by pressure in the medium.
4. **Drift:** Highly sensitive pressure sensors come with a certain amount of drift. This means that the error in the measurement value is not constant, but time-dependent. Of course, the error remains below the limit stated in the spec sheet. The drift usually takes the form of a creeping change in the offset. Therefore, in measurements of relative pressure, the offset should be tared to zero every once in a while. This can be done with the help of the operating software.
5. **Air bubbles:** Pockets of air must be avoided, especially with fluid media.
6. **Elevation differences:** If there is a difference in elevation between the sensor and the measurement site, the pressure differential affects the measurement. This must be taken account of, especially with fluids, and can be compensated by subtraction.
7. **Leaks:** Only the precise coupling mechanisms specified for the particular medium may be used or else you risk leakage.
8. **Low-pass:** When connecting the medium, the low-pass behavior of long tubes must be considered. To measure rapid pressure change, keep the tubing as short as possible.

Important note

You risk permanent damage by pulling the tube off self-closing nipples under high pressure. The pressure remains intact at the sensor. If the temperature rises subsequently, the sensor could be permanently damaged. Therefore, always ensure ventilation.

6.15.6 Sampling intervals, filters and anti-aliasing

For each of the 8 fast pressure channels, the sampling time can be freely set to between 1 ms and 60s. The pressure module comes with a fixed frequency hardware anti-aliasing filter, an analog-digital converter (ADC) according to the Sigma-Delta method and a digital low-pass filter adapted to the sampling rate.



On: Additional digital low-pass filter.
Off: Switch off the digital low-pass filter. The analog anti-aliasing filter takes always effect.
Mean value: The output value is averaged by (Sampling interval[ms] / 1 ms) samples.

The following table shows which resulting filter is to be used:

sampling rate	filter
1 ms	Critical damping, 4th order, cutoff frequency 250 Hz
2 ms	Critical damping, 4th order, cutoff frequency 120 Hz
5 ms	Critical damping, 4th order, cutoff frequency 50 Hz
10 ms	Critical damping, 4th order, cutoff frequency 25 Hz
20 ms	Critical damping, 4th order, cutoff frequency 12 Hz
50 ms	Critical damping, 4th order, cutoff frequency 5 Hz
100 ms	Critical damping, 4th order, cutoff frequency 2 Hz
200 ms	Critical damping, 4th order, cutoff frequency 1 Hz
500 ms	Critical damping, 4th order, cutoff frequency 0,5 Hz
1s	Critical damping, 4th order, cutoff frequency 0,2 Hz
2s ..60s	arithmetic mean over the duration of the sampling interval of values sampled at 1 kHz

The filters are optimized to provide good suppression of interference while causing only insubstantial signal surges in the time domain and only minor delay times. Note that the filters selected are not perfect anti-aliasing filters (e.g. with damping of 96dB at one-half of the sampling frequency).

If you use a sampling interval other than 1 ms and the default filter is not suited to your measurement requirements, simply select 1 ms as the sampling interval and then arrange the appropriate low-pass filtering or averaging by means of a virtual channel.

The frequency response only pertains to the device's electrical portion. The frequency response of the sensors themselves and of their leadwires is not accounted for.

6.15.7 Operating software

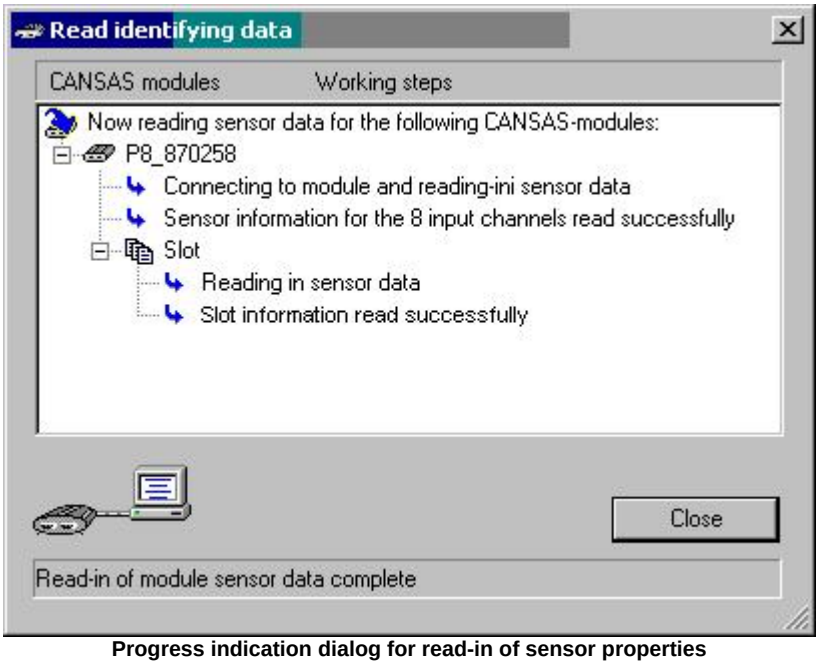
6.15.7.1 Module integration

To work with and make settings for a pressure module, it must first be entered in the database. This is done the usual way. When a new entry is made, the sensor's characteristic data are read in upon recognition of a pressure module and the input ranges for the channels are set accordingly.

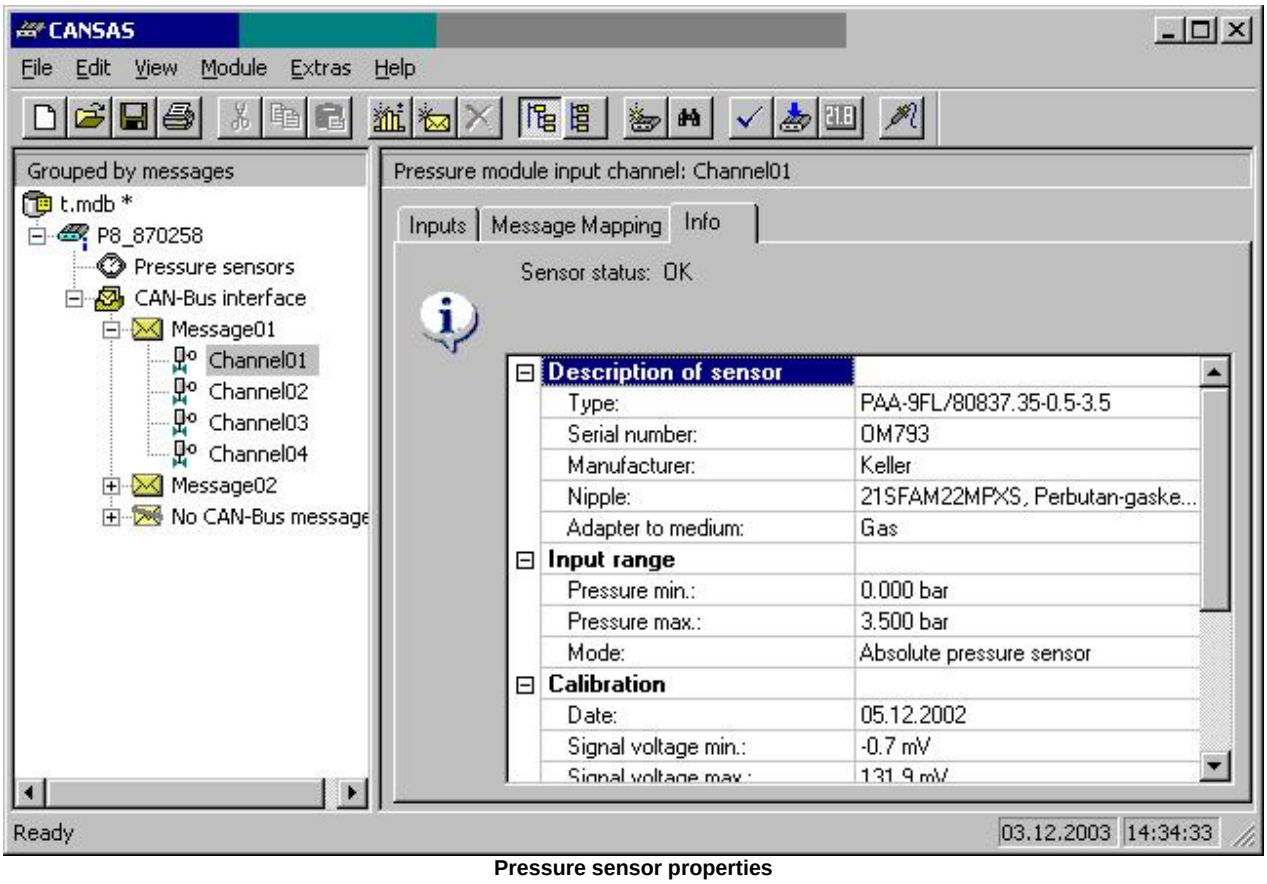
Attention when performing module integration off-line: Since there is no connection to an actual pressure module, all sensors are assumed to have an input range of 0..10 bar. If you already make the configuration for a module with its serial number entered correctly, it is still necessary to perform module integration of the module when it is first really connected, in order to have the input ranges correctly stated in the database.

6.15.7.2 Read-in of sensor data

If a pressure module is selected in the tree diagram on the left side of the user interface, it is possible to select the menu item *Module / Sensors / Read identifier data...* for that module (or alternatively, the corresponding toolbar button). This causes the characteristic data of all sensors to be read in. You can take a look at these characteristic data by selecting an individual channel of the module and accessing the index card *Info* on the right.


Read identifying data
CANSAS modules
Working steps
Now reading sensor data for the following CANSAS-modules:
P8_870258
Connecting to module and reading-ini sensor data
Sensor information for the 8 input channels read successfully
Slot
Reading in sensor data
Slot information read successfully
Close
Read-in of module sensor data complete

Progress indication dialog for read-in of sensor properties

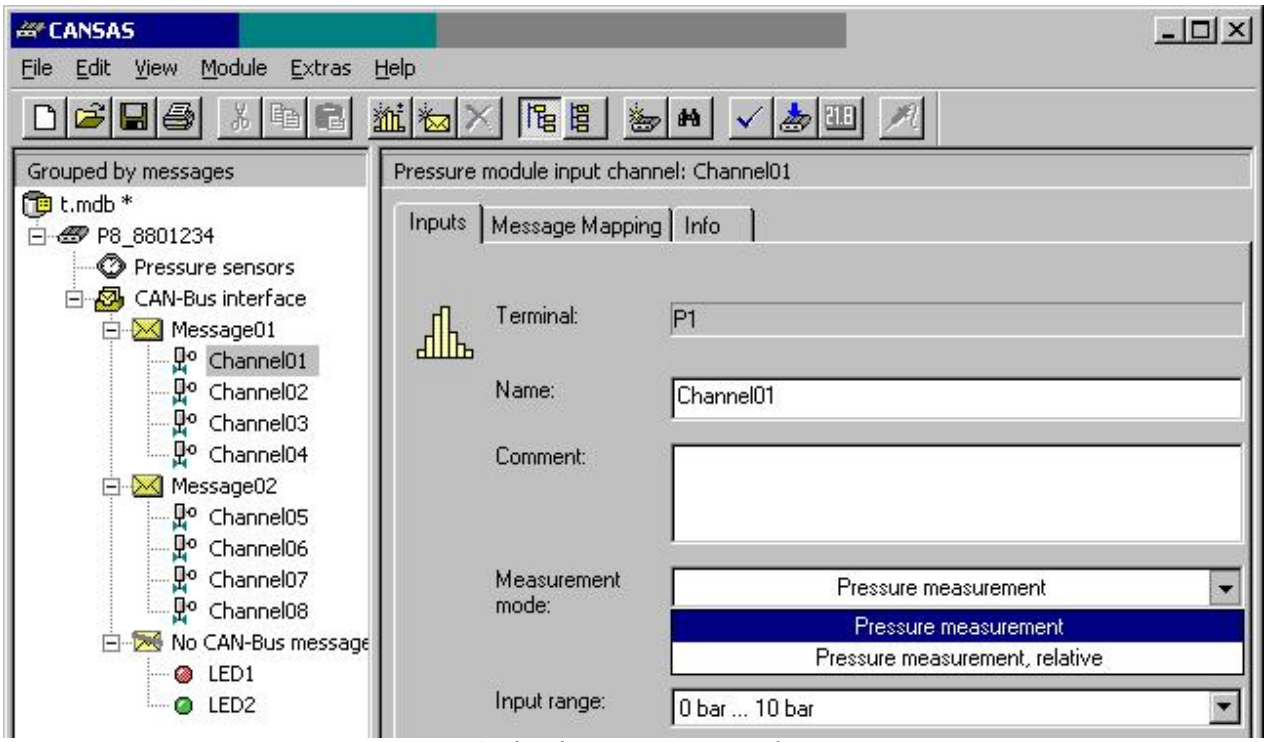


Pressure sensor properties

In addition, the characteristic data of the built-in barometers are also read in. These can be viewed by selecting *Pressure measurement* in the tree diagram and the index card "Barometer-Info" on the right.

6.15.7.3 Measurement mode

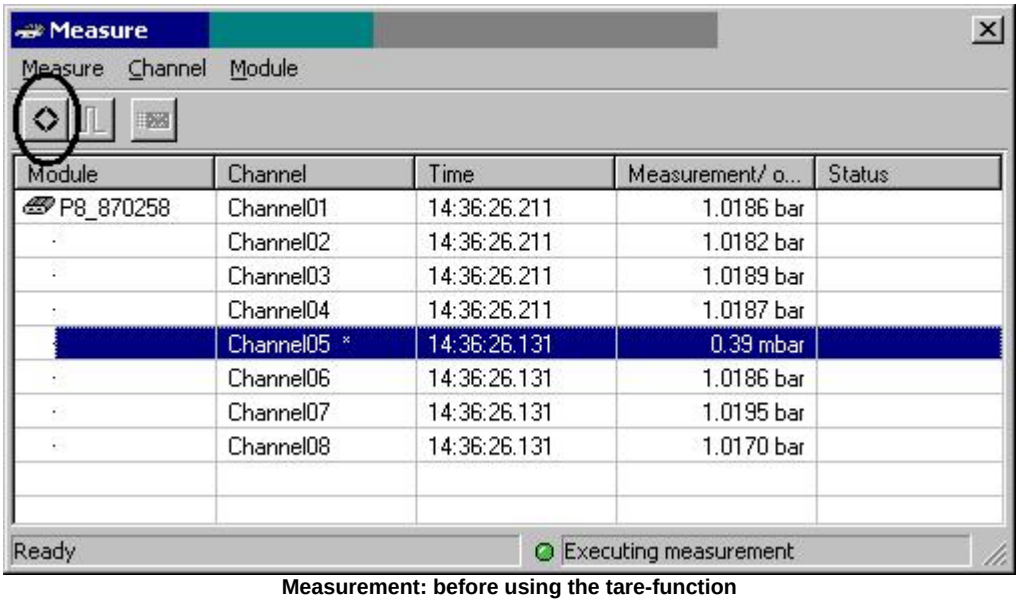
For the selected channels, the measurement mode "Pressure measurement" can be selected for absolute pressure measurements, or "Relative pressure measurement" for measurements of relative pressure. Note that absolute pressure sensors are also able to perform relative pressure measurements thanks to the built-in barometer. Relative pressure sensors, by contrast, can only measure relative pressure.



Setting the measurement mode

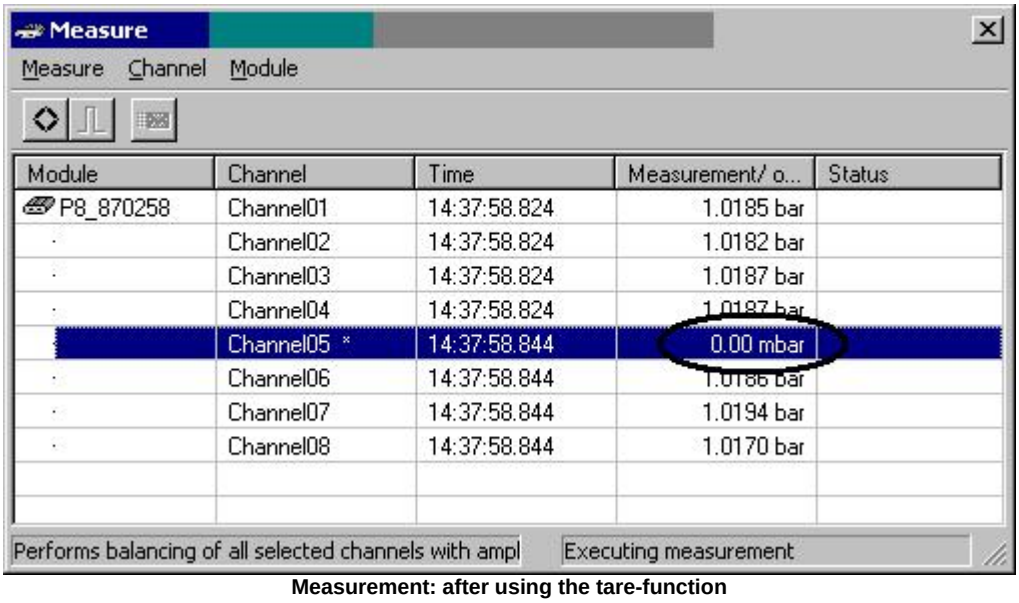
6.15.7.4 Balancing

To be able to zero-balance (tare) all relative pressure channels, you must first open the measurement window using the menu item *Module / Measure....* Before performing the balancing procedure, first disconnect the couplings from the pressure module's nipples after having made sure that the tubes are empty and that there is no large pressure differential to the ambient air. Then select the channels which you wish to balance. Then choose the menu item *Channel / Perform balancing for selections*.



Measurement: before using the tare-function

A few seconds later, the zeroing has been completed. The offset values are written to the module's Flash-EPROM and are subsequently used for corrections.



Measurement: after using the tare-function

The tare-function can only work if the relative pressure is near zero (which it should be in such a situation).

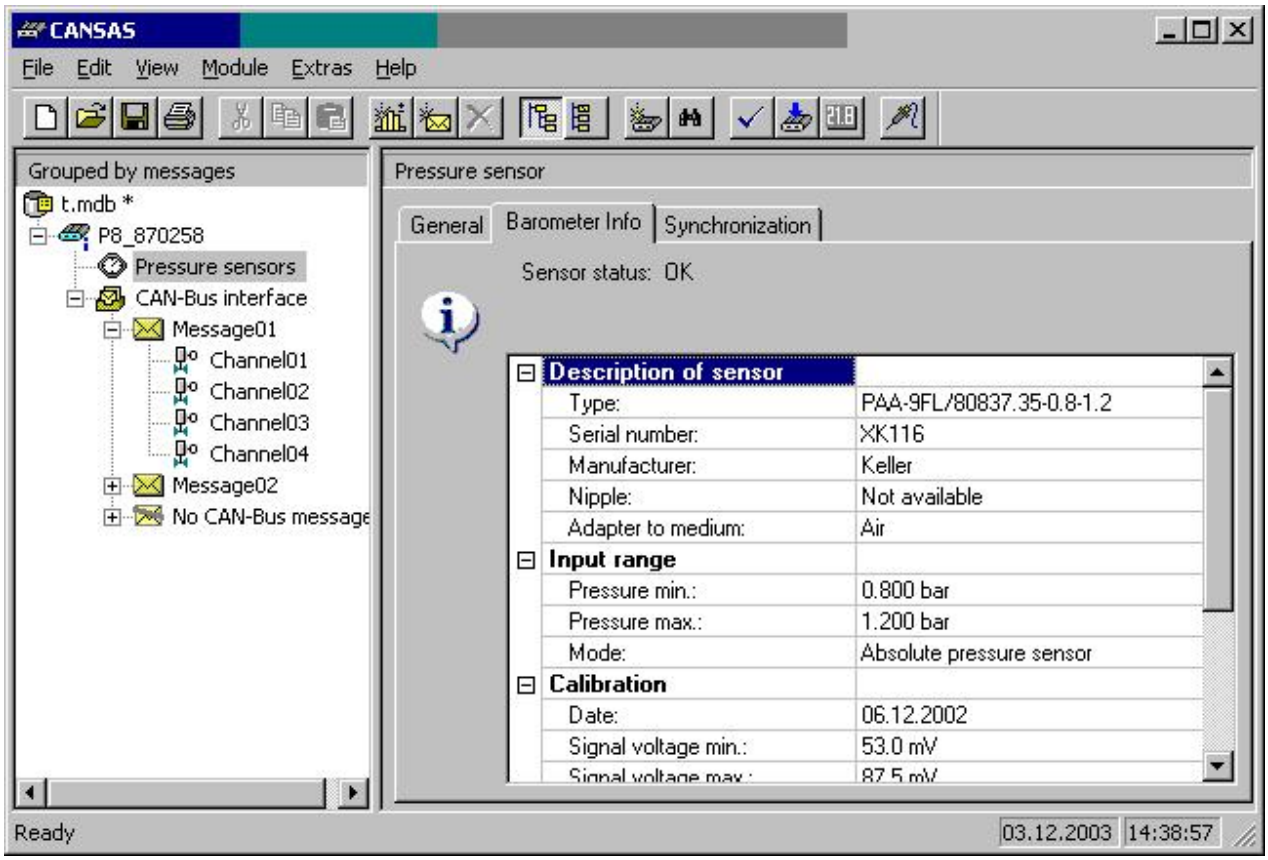
Taring for absolute pressure channels is not possible. If you have an offset to compensate in such a case, use a virtual channel.

Even after using the tare-function, the measurement value is usually not precisely 0,0mbar, but may be off by a few bits. The value is only 0,0 for the purposes of the measurement channel's specified accuracy.

6.15.7.5 Barometer

Each P8 pressure module is equipped with a barometer whose input range is 800 mbar.. 1200 mbar, enabling it to measure the pressure of the surrounding air. Its purpose is to determine the relative pressure in case an absolute pressure sensor is being used.

The information on the barometer's pressure sensor is available via the operating software. To access it, select in the tree diagram at left the entry "8 pressure sensors" and at the right, the index card *Barometer-Info*. Then select the menu item *Modules / Sensors / Read identifying data...* (or alternatively the corresponding button in the toolbar). Then the information will appear:



6.15.7.5.1 Barometer readings

The P8 pressure module comes with 8 high-speed inputs for external pressure channels. In addition, there is the built-in barometer, which is digitalized only very slowly. This is because the ambient air pressure is assumed to change only very slowly. The built-in barometer's readings can only be accessed using a virtual channel. To do this, create a virtual channel and select the function "Barometer". You can specify the rate at which the barometer's readings are to be subjected to further processing. Note that the barometer actually obtains a new reading only about every 1,2 s. All you can do is to set at which rate this value is queried, not measured. It hardly makes any sense to set a faster clock rate than 500 ms. Any subsequent processing should only be used in exceptional cases or for checkups. It should not be used to take the difference between an absolute pressure and a relative pressure reading. For such purposes, begin by setting relative pressure measurement as the channel's measurement mode. This will produce much better measurement results.

6.15.7.5.2 Built-in error recognition ("Min/Max values"):

If, after a brief self-diagnostic performed after starting up, the module detects an error in its analog portion or in the sensor recognition, the input range minimum of the channel affected is indicated. If this error occurs, it usually doesn't only affect this pressure sensor, but also the other channels. The P8-module must be repaired. In that case, please contact our Customer Support.

6.15.8 Maintenance

If nipples are not used (meaning: no couplings with tubes are attached), they should be covered with the included caps.

The nipples should always be kept clean.

The built-in barometer needs permanent contact to the surrounding air. In the (extruded) rack-housing, small air inlets are present. In the IP65-housing there are Goretex (R) membranes protected by plastic hoods. Always be sure that air can reach the module interior. Make sure the membrane is free of dust, grease and fluids. If it is clogged, the internal barometer will no longer work properly and relative pressure measurement cannot be performed.

Quick-release couplings and nipples are **expendable parts** not requiring maintenance if handled properly. However, if used with non-lubricating fluids, especially heavily degreasing fuels, it is necessary to apply lubrication regularly. The sealing region and actuating elements of couplings and nipples may require cleaning. Specifications of mating cycles (Chapter 7) always pertain to normal usage with proper care.

Installation notes:

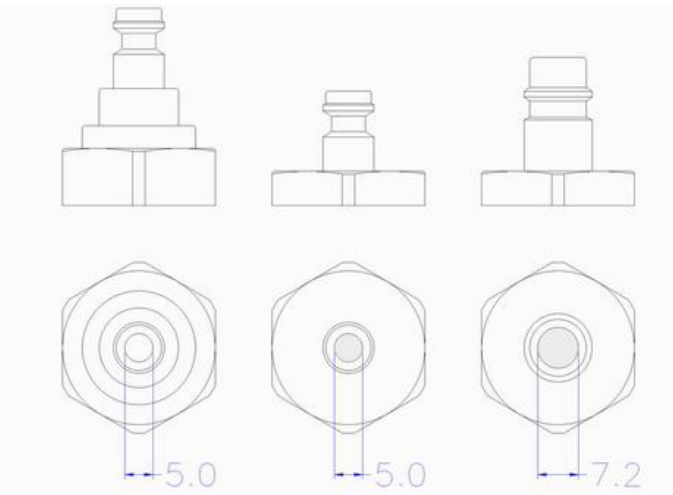
The permissible operating pressure of the tubes used must not be exceeded. The tubes must be attached in a manner which avoids slippage. Threading must be sealed properly, which means that the sealant must be compatible with the fluid, whether gaseous, vapor or liquid. Either quick-release coupling having a valve are to be used, or during use you must ensure that the flow is halted before de-coupling. If the connection point for the pressure measurement vibrates, it is necessary to hook it up to the quick-release coupling via a flexible tube which is at least 30 cm long in order to adequately isolate the coupling from the vibration. When couplings and attachments are not connected, they should be covered by protective caps to prevent contamination or other damage.

Caution!

When hooking up a coupling, especially one under pressure, fluid can escape. Be sure to take precautions against any dangers this could entail.

6.15.9 Pressure terminals, aggressive media

The eight measurement input nipples allow the measured substances to be hooked up directly and easily via quick-release couplings. An optional low-leakage model is available.



The properties of the sealing materials can be adversely affected by chemical and temperature processes. When selecting sensors, connector nipples, and couplings, be aware of the measured materials' chemical properties (see Chapter General technical specs 408). The temperature limits are also noted in Chapter General technical specs 380. The nipples' shape and material are of particular importance. For instance, nipples of brass and stainless steel are available. The type and material of the sealing gasket are also crucial and must be suitable for the medium to be measured.

6.15.10 Table of Chemical Resistance

All specifications are for orientation purposes only and no responsibility is taken for their correctness. They are meant to apply to 1) pure substances, 2) unless otherwise indicated, at room temperature, 3) for saline solution, acids and aqueous solutions, moderate concentrations. 1

A =resistant B =fairly resistant C =conditionally resistant D =not resistant

Medium	Sealant		
	NBR	FPM	EPDM
Acetate (ethyl- and amyl-)	D	D	B
Acetic acid 10%	D	B	A
Acetone	D	D	A
Acetylene	A		A
Alkalines			A
Alum	B	A	A
Ammonium nitrate	A		A
Ammonium sulfate solution	A		A
Ammonium, liquid	C	C	A
Amyl acetate	D	D	A
Amyl alcohol	B	B	A
Aniline	D	C	B
Barium chloride	A	A	A
Barium sulfide	A	A	A
Benzene	D	A	D
Blast furnace gas	D	A	D
Borax	B	A	A
Butane	A	A	D
Butyl alcohol	A	A	A
Calcium hydroxide	B	A	A
Carbon dioxide, dry	A	B	B
Carbon disulfide	D	A	D

Medium	Sealant		
	NBR	FPM	EPDM
Carbon-bisulfite		A	
Carbonic acid	B	A	A
Caustic potash	B	C	A
Chromate 10%	D	A	B
Citric acid	A	A	A
Coal gas		A	
Coke oven gas, hot	D	A	D
Compressed air	A	A	
Cooling water	A	A	
copper chloride	A	A	A
Creosote	D	A	B
Cresol		A	
Crude oil	A	A	
Cyclo-hexane	A	A	D
Diesel oil	A	A	
Diesel oil up to 120° C		A	
Emulsion, water-oil	A		
Ethanol amine	B	D	B
Etheric oils	B	A	
Ethyl alcohol	A	A	A
Ethylene	A	A	
Avgas BP, Exxon, Shell	A	A	
Aviation engine oil and turbine oil, Esso: 35	A	A	
Formalin	A		A
Formic acid	C	C	B
Frigen / Freon F 11-12	A	A	
Gas containing naphthaline		A	
Gasoline, refined	A	A	
Gear oil	A	A	D
Glucose	A	A	A
Glycerin	A	A	A
Glycol	A	A	A
Heat transfer oil up to 250° C			
Heating oil S	B	A	D
Heating oil up to 120° C			A
Heating oil up to 180° C			
Heating oil up to 200° C		A	
Helium	A	A	A
Hexane	A	A	D
Hydraulic fluid – Phosphate ester		A	
Hydraulic fluid HSA-oil in water	A	A	
Hydraulic fluid HSB-water in oil	A	A	
Hydraulic fluid HSC-Glycol-water	A	A	
Hydraulic fluid HSD-water-free		A	
Hydraulic fluid -hydrocarbons		A	
Hydraulic oil, mineral-based	A	A	D
Hydrogen cyanide	B	A	A

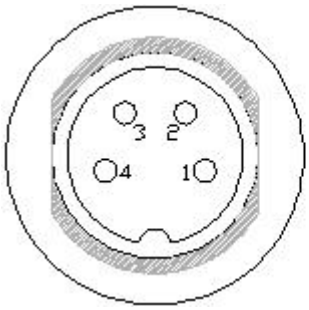
Medium	Sealant		
	NBR	FPM	EPDM
Hydrogen peroxide 10%	D	B	B
Hydrogen sulfide, dry	A	A	B
Hydrogen sulfide, moist	C	A	B
Hydrogen vapor 20° C	A	A	A
Illuminating gas	B	A	C
Isopropyl alcohol	A		A
Kerosene JP 1		A	
Ketone (Aethylmethyl)			A
Cresol, cresylic acid	D	A	C
Synthetic resin (no nitro solution).		A	
Latex, liquid	A		
Linseed oil	A	A	C
Lubricant oil	A	A	
Magnesium carbonate	A	A	A
Magnesium hydroxide	A	A	A
Magnesium sulfate	A	A	A
Mercury	A	A	A
Methane	A	A	D
Methanol CH3OH (pure)	C	D	A
Methyl alcohol	A	D	A
Methyl-Benzol		A	
Methylethylketon			A
Milk	A	A	A
Mineral oil	A	A	D
Naphtensäure	B	A	D
Naphtha	A	A	D
Naphthaline	D	A	D
Natural gas	B	A	D
Natural gas	A	A	
Nitric acid 33%		A	
Nitrogen	A	A	A
Nitro-solution, (no synthitic resin thinn)			A
Oleic acid	A	A	A
Oleic acid	A	A	
Oxalic acid	B	A	A
Paraffin	A	A	D
Pentachlorophenol	D	A	B
Petrolaether	A	A	D
Petrol	A	A	
Phenol solution		B	D
Phosphoric acid, cold <45%	B	A	A
Salt solution		A	A
Potassium cyanide	A	A	A
Potassium dichromate		A	A
Potassium sulfate	A	A	A
Propane gas	A	A	A
Saline solutions	A		B

Medium	Sealant		
	NBR	FPM	EPDM
Oxygen, fat free			A
Seawater	A	A	A
Soap solution.	B	A	A
Soda solution		A	A
Sodium acetate	B	D	A
Sodium bicarbonate	A	A	A
Sodium carbonate (soda)	A	A	A
sodium chloride (table salt)	A	A	A
Sodium cyanide	A		A
Sodium hydroxide 20%	D	B	A
Sodium sulfide	A	A	A
Spirits of ammonia	A		A
Sulfur dioxide, gas	D	A	B
Tar	B	A	D
Titanium tetrachloride, Titanium (IV) chloride	B	A	D
Toluene	C	A	
Toluene, dry	D	A	D
Town gas	B	B	D
Transformer oil	A	A	D
Transmission oil	A	A	D
Trichloroethylene ("Tri")	C	A	D
Turbo oil MIL-L-7808	B	A	D
Vacuum (reinforced valve springs)	A	A	
Vapor up to 170° C = 8,076 kp/cm²	D	D	A
Vapor up to 250° C = 40,56 kp/cm²	D	D	D
Vegetable oils	A	A	D
Water above 80° C		A	A
Water up to 80° C	B	A	A
Water, de-ionized	A	B	
Water, demineralized	B	B	
Water, distilled	C	B	A
Xylol	D	A	D

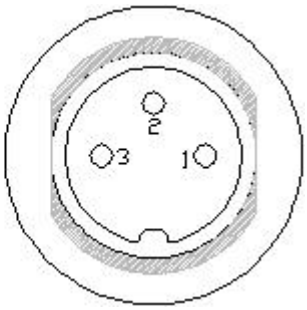
1 Source: "Walther Präzision Schnellkupplungssysteme" At the time stated, the information provided was correct to the best of our knowledge; however we offer no guarantee either explicitly or implicitly that components manufactured from these materials will function satisfactorily in the applications intended by the customer. The customer bears sole responsibility for evaluating the components prior to using them, especially in applications in which component failure can lead to injury and/or damage of property. Please note that the elastomer parts have a limited lifespan and that we therefore strongly recommend a program of inspection and replacement carried out at regular intervals. All specifications on the material are intended strictly for orientation purposes. Every application is subjected to unique environmental influences which must be taken into account when selecting materials.

6.15.11 Pin configuration of CANSAS-P8-IP65

In contrast to the connector design 433 of CANSAS-L-P8, the pin configuration for CANSAS-IP65-P8 is as presented in the table below.



CAN connector



Supply-plug

Pin-assignment	CAN	Supply
1	CAN High	+SUPPLY (+9 V to +32 VDC)
2	CAN Low	-SUPPLY (0 V)
3	CAN Gnd	Reset
4	SYNC	ground
Chassis	lead shielding	

6.15.12 CANSAS-IP65-P8-E

In contrast to the standard CANSAS-IP65-P8 module, this module comes with two CAN terminals and two Power sockets. This makes it possible to connect the CAN-Bus through it.

The interconnections used are the Amphenol terminals described above. The CAN terminal and Power terminal pairs are each connected in parallel. Internal 120 Ω terminators of the CAN-bus are generally omitted, but can optionally be applied internally.

In this model, all terminals are positioned on the top. Four channels apiece measure in the input ranges 0-6 bar and 0-10 bar.

For connection to the CAN-Bus and the power supply, an adapter kit is to be used which consists of:

CAN - Adapter:	DSUB9 4-pin Amphenol	⇔	4-pin Amphenol or 4-pin Amphenol
Supply	4-pin Phoenix 3-pin Amphenol	⇔	3-pin Amphenol or 3-pin Amphenol

Terminations: external 4-pin Amphenol plug (120Ω between PIN1 and PIN2)

Reset: as with all IP65 P8

6.15.13 Grounding

CANSAS P8 should be grounded. Its housing is metal and conducting, which means that grounding is advisable for safety reasons. But grounding also makes sense for measurement-technical reasons, but isn't totally necessary when using plastic tubes. Lack of grounding can cause noisy measurement values, however.

For CANSAS-L-P8, ground connection via a bolt on the backplane is recommended.

For CANSAS-IP65-P8, ground connection via the plug housing is recommended.

6.16 PWM8 pulse width modulation outputs

8 digital outputs

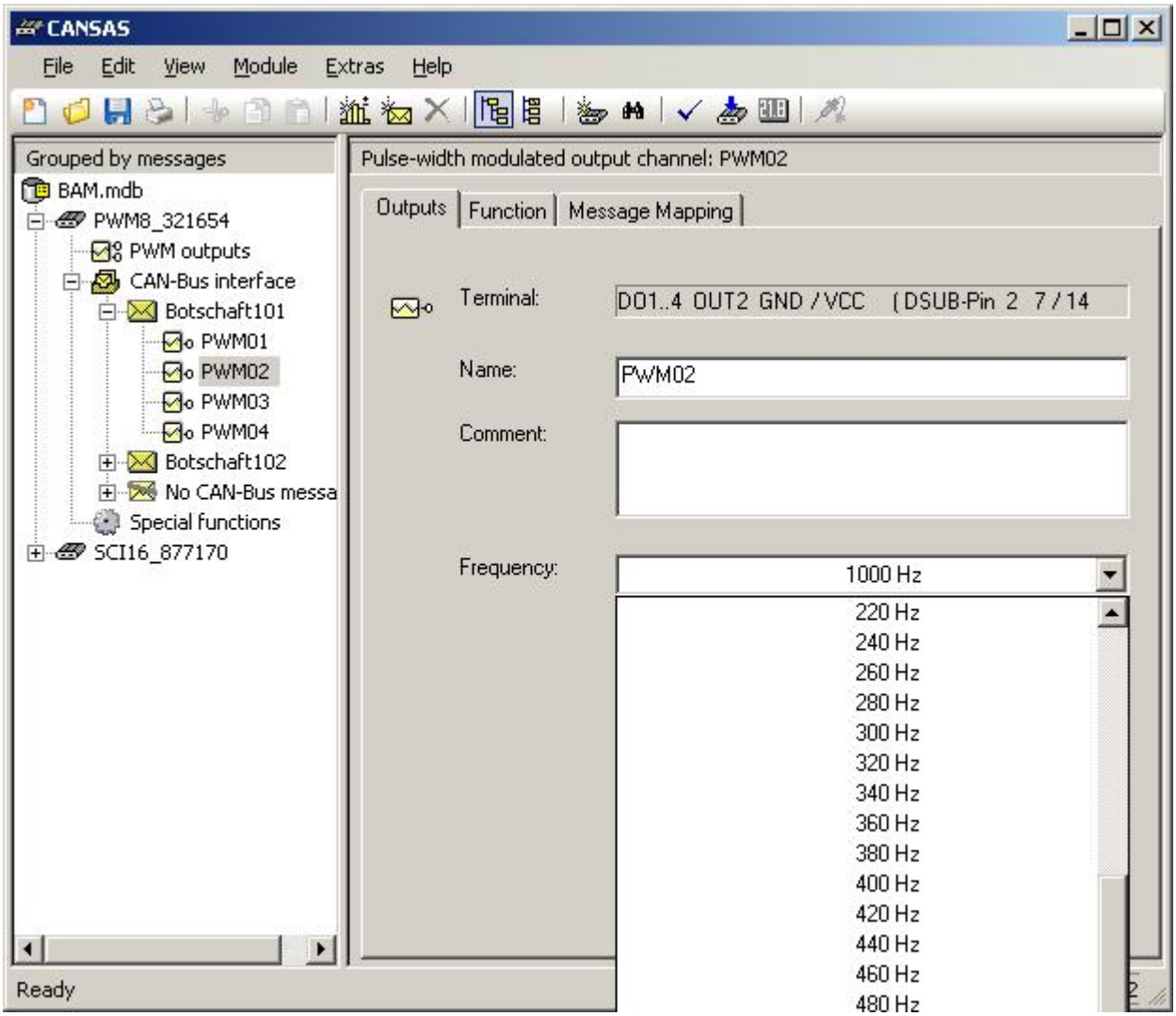
Parameter	Value (typ./max.)	Remarks
Channels	8	Separate voltage supply for the two channel groups. The 4 outputs in a connector are isolated from the outputs of other connectors, from the supply and from the CAN-bus, but not channel-to-channel.

Technical data PWM8. 410

6.16.1 8 PWM outputs

For purpose of using pulse width modulation as a control signal, the PWM (pulse width modulation) is used. For the output, you can choose between TTL and an external voltage source (Open Drain).

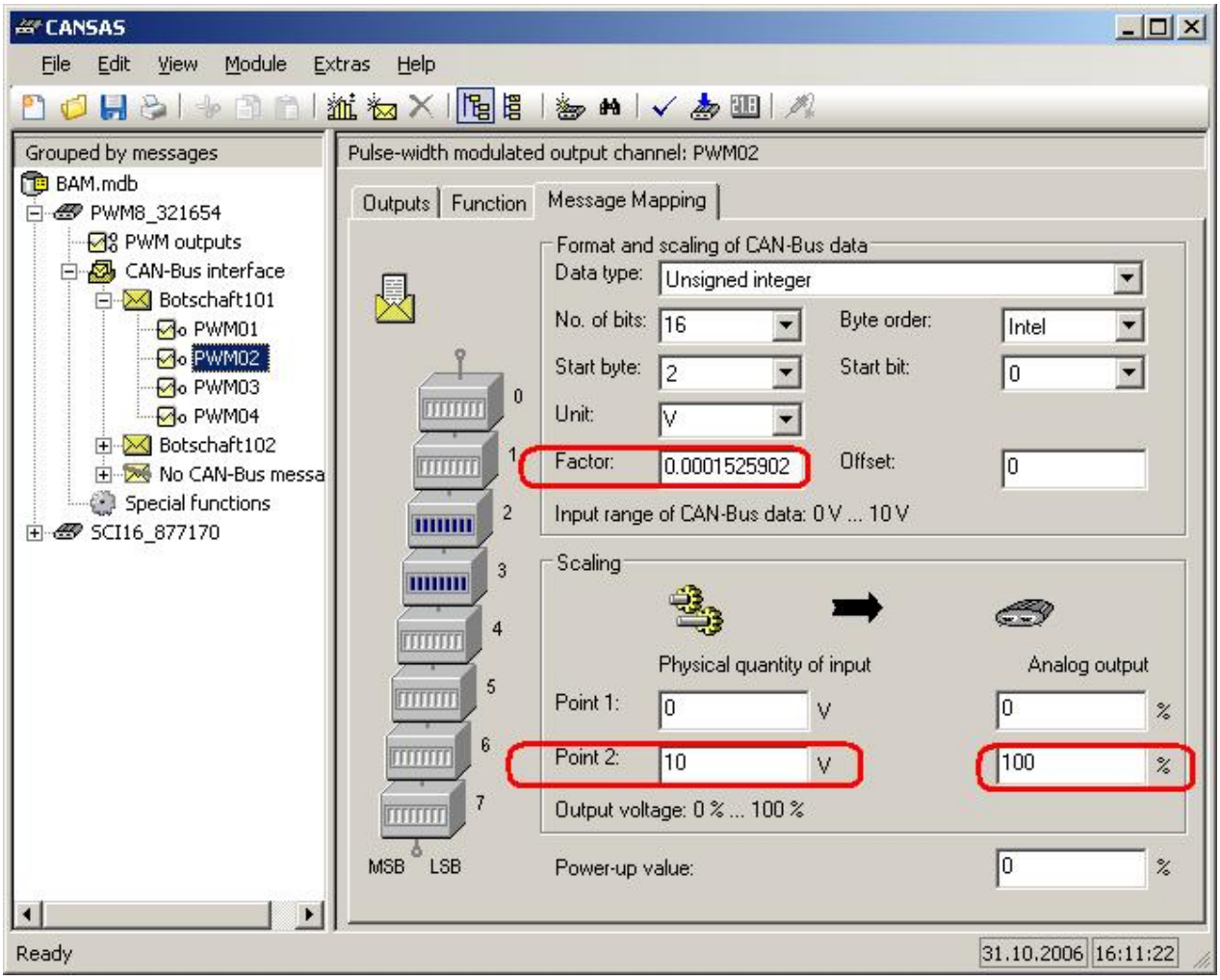
The frequency is fix and can be be set individually for each channel:



Each 4-channel group in a connector is isolated from the other connector's channels and from the power supply and CAN-bus.

6.16.2 Scaling

The scaling of the duty cycle ratio has to be entered on the *Message Mapping* card:



Per default the physical quantity of input is set to 0-10 V. To use the possible integer range of 2^16, a value between 0 and 65535 is expected. A factor of 1,525902e-4 multiplies a result to a maximum of 10 V.

Alternative a factor of 1 causes a range of 0 to 65535 (V) :

CAN message	PWM output
65535	100 %
32767	50 %
6554	10 %
0	0 %

6.16.3 Delay time

The delay time varies between the arrival of a new PWM-value in a CAN message and the PWM output. It depends on the internal condition of the module. The time can be calculated like this:

T_delay = T_process + T_period

T_process = A value between 0,2 ms ...1 ms. It is the time to get the CAN-bus message, to proceed and send it to the PWM output.

T_period = 0...1/***F_output***

F_output is the selected output frequency (cycle duration of the PWM-signal). A new PWM-value can be proceeded not before the previous cycle is over.

Example: The output frequency is 10 kHz (= 0,1 ms PWM-cycle duration).

T_delay_min = 0,2 ms + 0 ms = 0,2 ms

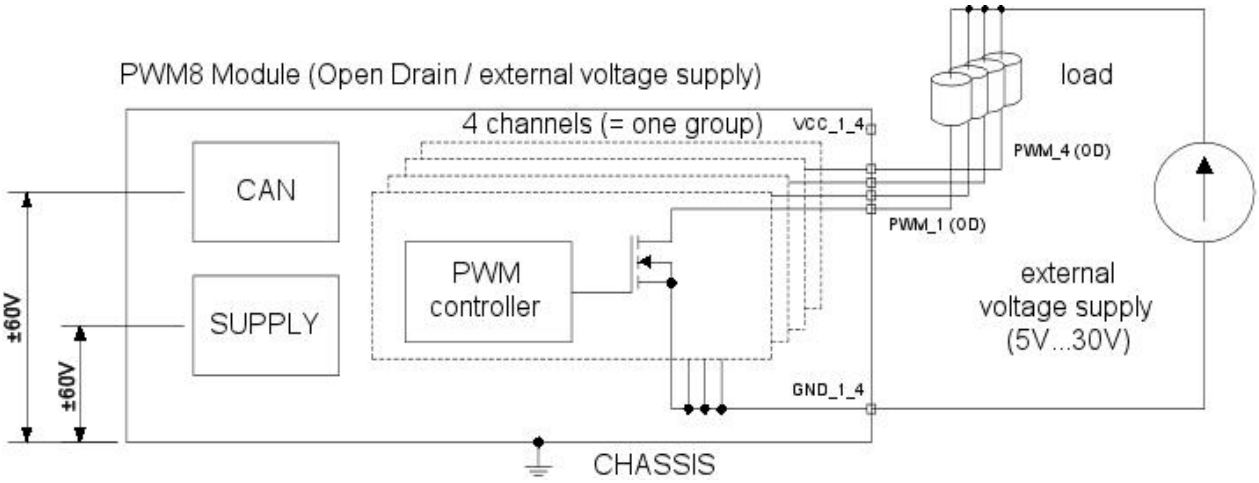
T_delay_max = 1 ms + 0,1 ms = 1,1 ms

6.16.4 Connection PWM8

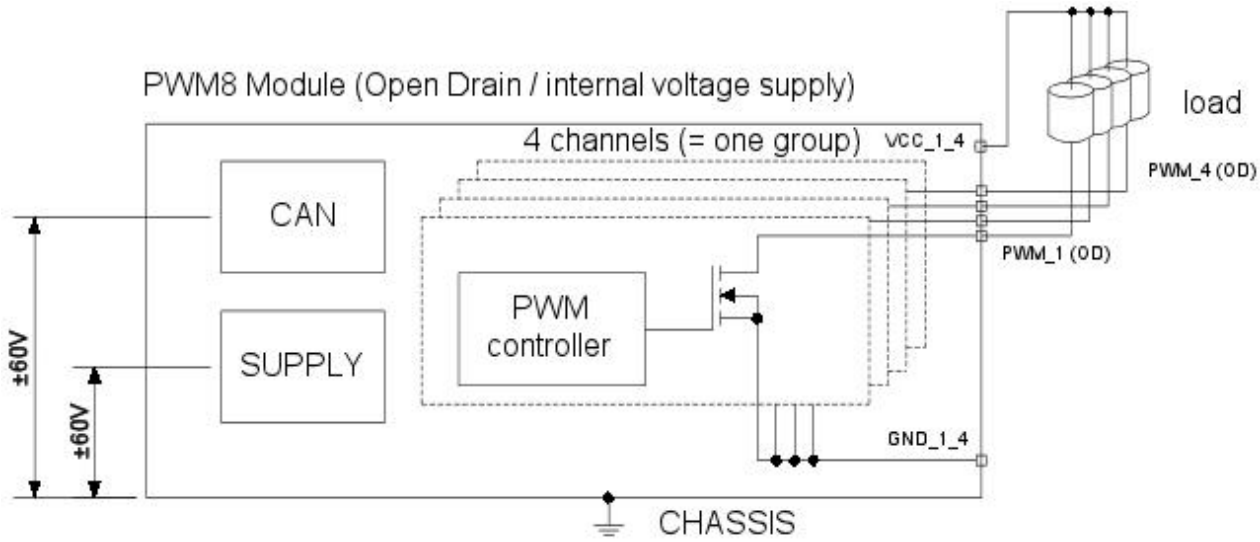
For the pin assignment of the DSUB-15 plugs see here 445.

Pin configuration of CANSAS-L-PWM8-V_with_ITT_VEAM_terminals 454. The CANSAS-K-PWM8-BNC is equipped with BNC connectors.

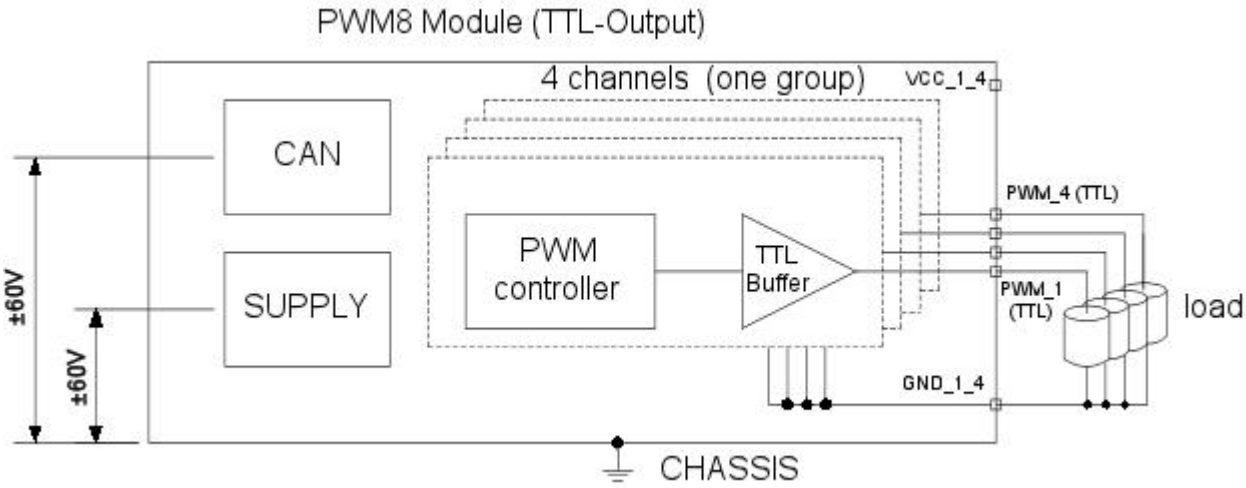
Outputs configured as Open drain with *external* voltage supply



Outputs configured as Open drain with *internal* voltage supply



Outputs configured as TTL



6.17 SC16, SCI8, SCI16 voltage, current and temp. modes

8/16 differential, analog inputs

Parameter	Value (typ. / max)		Remarks
Channels CANSAS-SC16, SCI16 CANSAS-SCI8	16 8		4-channel groups on 4 x DSUB-15 4-channel groups on 2 x DSUB-15
Measurement mode (DSUB) CANSAS-SCI-8, SCI-16 CANSAS-SC-16 CANSAS-SCI-8, SC(I)-16	voltage ≤ 60 V voltage ≤ 10 V voltage ≤ 60 V thermocouple, RTD (Pt100) current		standard-plug (ACC/DSUB-U4) standard-plug (ACC/DSUB-U4) divider-plug (ACC/DSUB-UD4) thermo-plug (ACC/DSUB-T4) shunt-plug (ACC/DSUB-I4)
Measurement mode (SL DSUB) CANSAS-SL-SC16-D	voltage ≤ 10 V		ACC/DSUB-U4-IP65
Measurement mode (SL LEMO) CANSAS-SL-SC(I)16-L CANSAS-SL-SCI-8	voltage ≤ 10 V RTD (Pt100) current		
Measurement mode (TK-plug) CANSAS-L-SC16-2T, -L-SCI8-2T, -L-SCI8-2T-Y, -K1-SC16-2T	thermocouple, type-K	-Y = yellow, otherwise green	

Technical data SC16 411 and the technical data SCI8 and SCI16 414

The CANSAS modules SCI8, SCI16 and SC16 have 8 or 16 input channels respectively. The modules belonging to the SCIxx group (SCI8, SCI16) have extended isolation properties, with channel-to-channel isolation and common mode voltage of up to 60 V (with a test voltage of 300 V). The SC16's isolation voltage values are limited to 40 V (Common mode voltage and max. protected channel-to channel isolation) at a working range of channel to channel isolation of 15 V (for specified accuracy).

All SC variants (from March, 2006) support **TEDS** to read and write sensor information.

Beside working with CAN-bus per default, the modules are also configurable as **CANopen**® modules.

All three modules of this family are based on a scanner concept with block isolation, in which a multiplexer is combined with an isolated measuring amplifier. In the SC***I***xx group, the switching matrix is realized with ***optical*** relays, which offers extended isolation properties compared to the SC16 which has ***electronic*** switches. What both groups have in common is that the inputs are provided with differential properties by a measuring amplifier isolated block-to-block, which adjusts itself to the respective common mode voltage of the connected source. This adjustment of the voltage entails reverse-charging of the capacitors present and thus a short-term burden on the signal source. If the signal voltage is unaffected by such factors (e.g. in the case of thermocouples, batteries, and PT100-units fed from the SCxx- module), there is practically no compromising of the measurement in any typical applications, since the measurement system automatically compensates for the feedback effect. The maximum allowed source impedance (refer to the technical specs) which may not be exceeded is so high that it doesn't usually present any limitations. Due to this property, however, the modules belonging to this family are not suitable for signal sources which respond to these dynamic feedback effects. This can apply to active sensors or calibrators, for instance, whose output level is low-frequency filtered or which is not able to correct quickly enough for the dynamic load fluctuations.

The choices for signals to connect include ***voltage***, ***current***, or any DIN-***thermocouples*** or ***PT100***s. The "Opto"-modules SCI8 and SCI16 enable direct connection of signals up to ±60 V. SC16, by contrast supports input ranges of ±100 mV to ±10 V directly and supports the extended input ranges up to ±60 V by means of a special divider connector (ACC/DSUB-UD4).

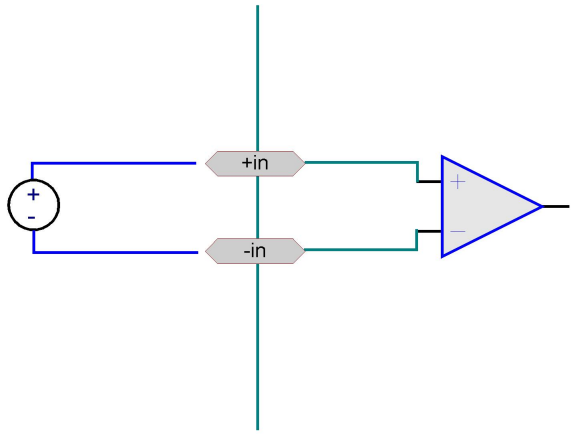
The ***interconnections*** used are ***DSUB-15*** terminals. One connector serves four signals.

Each channel can be connected individually which means it's possible to connect a voltage, a temperature and a current all via on terminal. This can result in certain limitations if, for instance, a current measurement is carried out with a shunt connector and a temperature measurement with a thermocouple. Since these measurement types require a dedicated connector, only one measurement type can be performed per DSUB.

In principle, it's possible to carry out both a voltage measurement and a thermocouple measurement using the same thermo-connector. Likewise, a PT100 measurement can be carried out using just a standard connector, although doing this would prevent the convenient four-wire connection scheme from being used.

To avoid ***crosstalk***, which is typical for scanner systems, it is recommended to ***short circuit*** the inputs of the channel, which are not in use.

6.17.1 Voltage measurement



- ±60 V... ±100 mV (only SCI8, SCI16)
- ±10 V... ±100 mV (SC16)
- ±60 V bis ±20 V (SC16 with divider plug)

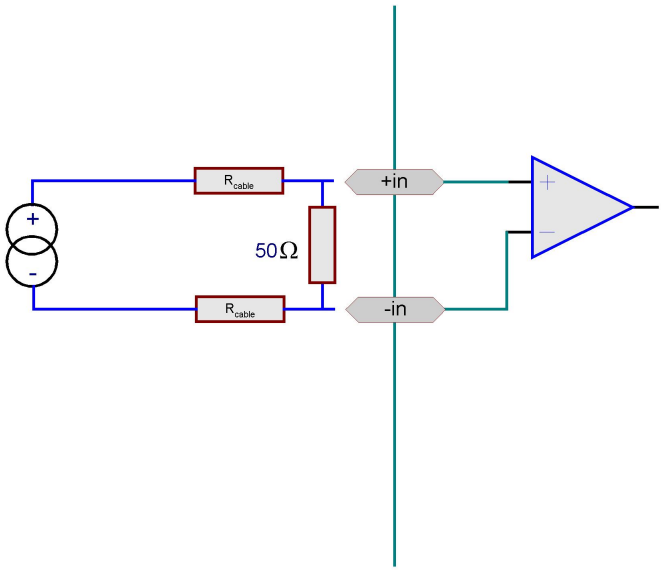
The input impedance in the ranges ±20 V and ±60 V is 1 MΩ, otherwise 10 MΩ. The input configuration is differential and DC-coupled.

The standard connector is used for voltage measurement (ACC/DSUB-U4); the thermo-connector (ACC/DSUB-T4) is also supported.

The terminal "(GND)" must not be connected, especially not grounded!

The connection schemes for isolated and non-isolated signal sources are indistinguishable!

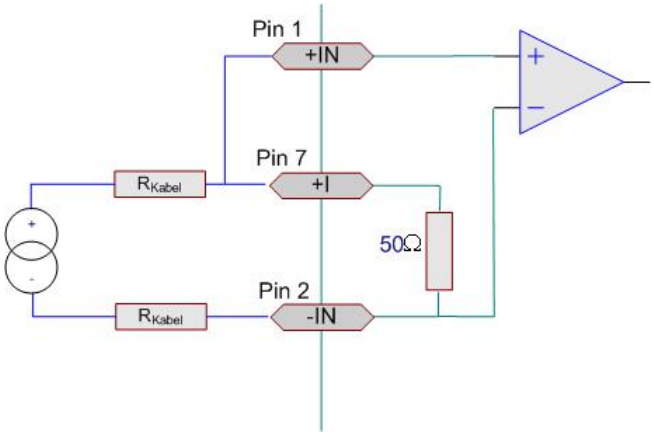
6.17.2 Current measurement



- ±40 mA ... ±2 mA

For current measurement, a **shunt** is built into the imc current connector (ACC/DSUB-I4).

The terminal "(GND)" must not be connected, especially not grounded!

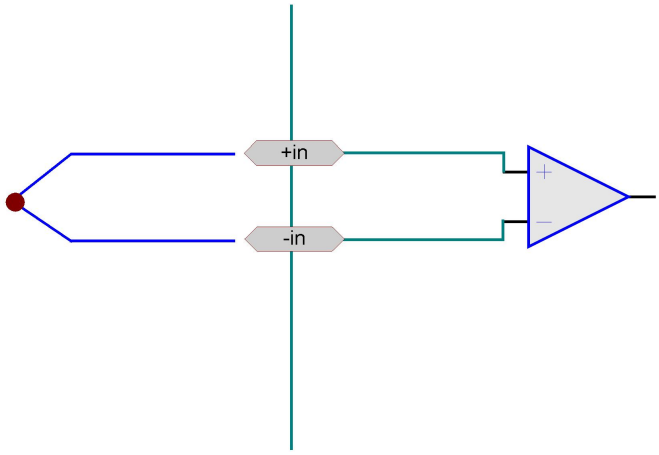


With the housing **model SL** with **LEMO** connectors, current measurement is connected via an internal 50Ω shunt. Toward this end, the current signal is connected at the pins +I and -IN. For current measurement, the pins +I and +IN must be shorted. This connection may only be made for current measurement purposes, and must be cleared for all other measurement types. For this reason imc offers a cable specially constructed with this connection exclusively for current measurement.

6.17.3 Temperature measurement

The input channels are designed for measurement with **thermocouples and PT100**-sensors (RTD, platinum resistance thermometers as per DIN and IEC 751). Any combinations of the two sensor types can be connected.

6.17.3.1 Thermocouple measurement

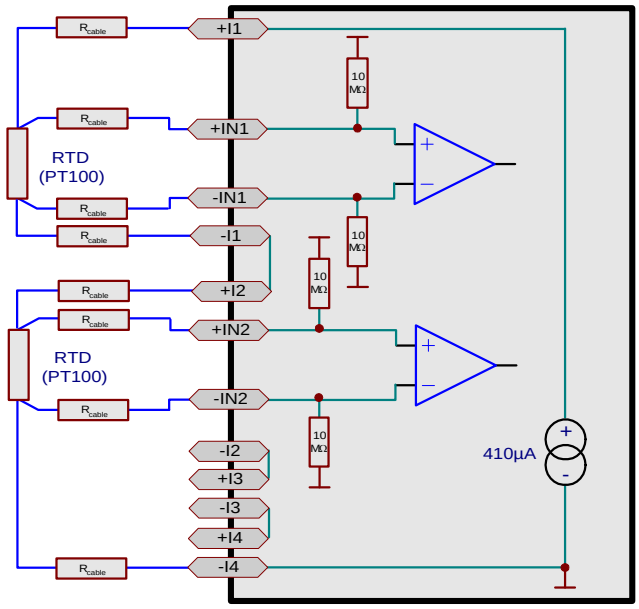


The common thermocouple types make use of linearization by characteristic curve. All common thermocouple types with their characteristic curves are supported. A combination of thermocouple measurement and Pt100 measurement is possible.

The cold-junction compensation necessary for thermocouple measurements is built into the imc thermo-connector (ACC/DSUB-T4 450).

> Effective suppression of 50 Hz or 60 Hz signal components can only be guaranteed for sampling rates of 1s or slower (SCI8 from 0,5s).
>
> For further information see Chapter: Measurement technique – sampling rates, scanner-concept 182.

6.17.3.2 PT100 (RTD) - Measurement



Along with Along with thermocouples, ***PT100*** sensors can also be connected, in ***4-wire configuration***. An extra reference current source feeds an entire chain of up to four serially connected sensors.

The imc thermoplug has 4 contacts which are available for the purpose of 4-wire measurements. These current-supply contacts are internally wired so that the reference current loop is automatically closed when all four PT100 units are connected. This means that the–I contact of one channel is connected to the +I contact of the next channel (see the sketch here 450). Therefore, for channels not connected to a P100 sensor, a wire jumper must be used to connect the respective "+Ix" and "-Ix" contacts.

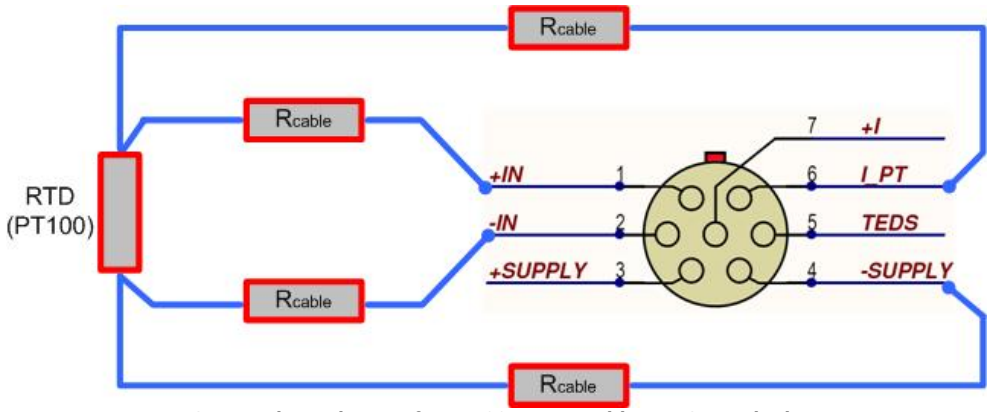
Normal DSUB-15 connectors don't come with these extra "auxiliary contacts" for 4-wire connections. This means that you must take steps to ensure that the reference current flows through all PT100 units. Only "+I1" (DSUB(9), Terminal K1, "(RES.)") and "–I4" (DSUB(6), Terminal K10, "(GND)") are available as a contact or DSUB-15 pin, respectively. The connections "–I1 = +I2", "–I2 = +I3", and "–I3 = +I4" must be wired externally.

PT100 sensors are fed from the module and have no set voltage reference in the sense of an external common mode voltage. It is also not permissible to set one up, for instance by grounding one of the four connection cables:

The PT100 reference current source is connected to the internal reference of the differential amplifier, which has block-to-block isolation. It thus assumes the common mode voltage of all other connected channels by turns, as long as they are operated in mode other than PT100.

6.17.3.3 PT100 (RTD) - Measurement (Type: LEMO)

With the LEMO terminals at the IP65 housing SL it's only possible to connect ***PT100 sensors*** directly in ***4-wire-configuration***. A (supplementary) reference current source feeds the sensor. How to connect a PT100 sensor is shown below.



Connection scheme of a PT100 sensor with LEMO terminals

6.17.3.4 Probe-breakage recognition

SC modules come with the ability to recognize breakage in the probe lines. In case of a breakage within a short time (only a few samples), the measurement signal generated by the module approaches the bottom of the input range in a defined pattern. The actual value reached depends on the particular thermocouple. In the case of Type K thermocouples, this is around 270 °C. If the system is monitoring a cutoff level with a certain tolerance, e.g. "Is the measured value < -265 °C", then it's possible to conclude that the sensor is broken, unless such temperatures could really occur at the measurement site.

The bottom of the input range will be displayed:

- if at least one of the ***thermocouple's*** two lines breaks
- if a channel is parameterized for "Thermocouple" and measurement starts without any thermocouple being connected.
- if the cold junction compensation is missing
- For PT100 in case of a short-circuit.

For PT100, note that in a 4-wire measurement a large variety of combinations of broken and shorted leads are possible. Many of these combinations, especially ones with a broken Sense lead, will not return the default value stated.

6.17.3.5 Deactivate probe-breakage recognition

In case the temperature measurement is checked by a controlled calibrator, an interaction might evolve between the high impedance calibrator output and the device input. Than the signal comes in noisy and not usable for calibration. The following procedure can be used to deactivate the probe-breakage recognition:

Message 1:

The CAN-ID is the master-ID of the configured module (default: 2032). 8 bytes, Intel-format.

Contents	0xC0	0x00	Slave-ID (Standard 2033)	0x00000000
Bit	0-7	8-15	16-31	32-63

Message 2:

The CAN-ID is the master-ID of the configured module (default: 2032). 8 bytes, Intel-format.

Contents	0xC5	0x00	Serial number	On-/Off-command	0x00
Bit	0-7	8-15	16-47	48-55	56-63

- Serial number of the module as 32 Bit number
- Command to activate the probe-breakage recognition: 0x11
  Command to deactivate the probe-breakage recognition: 0x10

After the module has executed the second message, the module sends an answer message using the slave-ID.

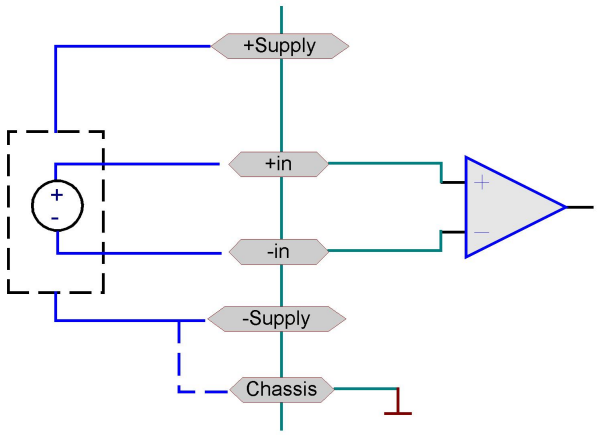
Example to switch of the probe-breakage recognition:

Slave-ID for this example is 2033
Serial number of the example module is 871682

```
The message on the bus would look like:
message 1: c0 00 f1 07 00 00 00 00
message 2: c5 00 02 4d 0d 00 10 00
answer      c6 xx xx xx xx xx xx xx
```

The effect of that change takes up to several 100 ms.

6.17.4 External sensor supply (optional)



The modules SCI8, SCI16 and SC16 can optionally be equipped with a sensor supply. The supply is unipolar and connects to the DSUB-15 terminals. The voltage is globally adjustable from 2,5 V to 24 V and applies to both connection terminals.

Bipolar supply voltages are not supported with these modules.

The sensor supply voltage is always isolated (by block), both to the frame and to the block-isolated amplifier potential. In order to avoid that the common mode voltage is uncontrolled (due to isolation drift or capacitive interference), it should be determined externally. Unless this is already handled by the connected sensors, it can be accomplished by means of a connection to the module's CHASSIS.

The contact "(GND)", by contrast, must not be connected and especially not grounded!

The supply voltage is set on a module-by-module basis and does not apply to all inputs.

Important: The settings are made via software interface. Make sure that the sensor supply is not set too high ***before*** connecting a sensor. Otherwise, both the sensor and the CANSAS module could suffer damage.

Technical specification sensor supply. 427

6.17.5 Connector plugs SC16, SCI8, SCI16

For the pin assignment of the DSUB-15 plugs see here. 445

The concept of block-level isolation is associated with certain crucial constraints which affect the use of the connection terminals or the grounding of certain contact pins:

Example: Voltage measurement with ACC/DSUB-U4, current measurement with ACC/DSUB-I4:

The terminals designated "(GND)" may not have external connections or have externally determined voltage levels, and in particular may not be grounded!
They carry the internal isolated reference potential of the block-wise isolated input amplifier ("GND_ISO").

Pin(1) of the DSUB-15 connector also has a particular feature:

It carries a signal which serves the purpose of TEDS sensor recognition. This signal, too, is referenced to the internal, block-wise isolated parts of the circuit and may not be grounded (CHASSIS).

For this reason, not in particular:

For SCxx / SCIxx –modules, only connectors of the type "ACC/DSUB" or of the "TEDS/DSUB" group may be used!

Only these connectors, in contrast to those previously used, have NO connection from DSUB(1) to CHASSIS.

If "conventional" connectors are used which have this connection, the module's block-wise isolation would be cancelled! This would also mean the loss of the measurement inputs' differential properties and thus of the module's fundamental functionality. Protection mechanisms prevent module damage in such cases, but instead, apparently "random" measurement errors as well as "mysterious" effects can result!

SC-modules higher than PD50 (February 2007) support ***TEDS***.

6.17.5.1 SL Variety LEMO

see pin configuration of LEMO terminals 455.

6.17.6 Sampling rates

The explanations provided in Chapter "Measurement technique", "*Sampling rates – Scanner concept* 182" reveal the following advantages and constraints:

Advantages:

- flexible configuration of slow precision measurements and high-speed voltage measurements with one and the same affordable scanner system
- optimal aliasing-free noise suppression of even 50 Hz interference in spite of relatively high bandwidth of a scanner amplifier

Constraints:

- the highest sampling rate (of all those used, even of the channels used to derive virtual channels) determines the averaging interval and thus the noise suppression properties of *all* channels
- extra signal transit time due to automatic time offset correction is determined by the highest sampling rate.

Maximum sampling rate, recommended for temperature measurement (optimum 50 Hz noise suppression):

SCI8:	**>= 500 ms (2 Hz)**
SC16, SCI16:	**>= 1s (1 Hz)**

6.17.7 Isolation - Concept

The modules SCI8, SCI16 and SC16 are based on a "scanner"-concept: the channels are sampled in succession and connected with an isolated differential amplifier. The potential levels between the signal source and amplifier are compensated by adapting the amplifier's supply reference to the source's common mode voltage, namely via a (low-impedance) switch.

The difference between SC16 and SC***I***16 consists mainly in the ***maximum possible isolation voltage*** of their channels.

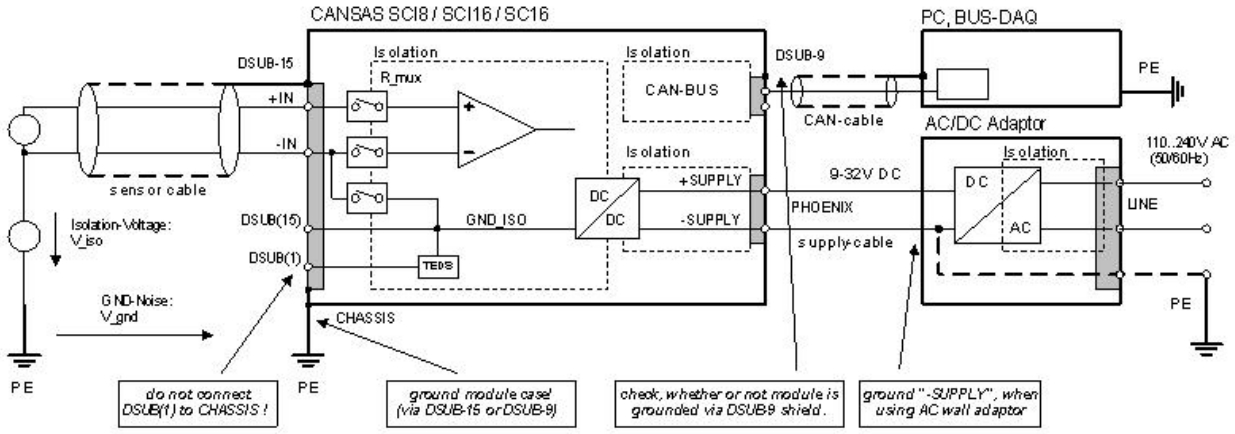
What all modules have in common is their design as an isolated differential amplifier with "block"-isolation. Block isolation refers to the fact that the input channels are not only isolated from each other (max. 60 V for SCI-x modules, 15 V for SC16), but additionally isolated as a group ("en bloc") from the frame, to a degree which can even exceed the maximum channel isolation strength (max. 60 V for SCI-x modules, 40 V for SC16). This isolation strength is known as the "maximum common mode input voltage".

Due to the components used, the channels of SCI8 and SCI16 units are mutually isolated to a strength of 60 V.

With SC16, then, the maximum input voltage at an input pin may exceed the frame's voltage level by up to 40 V ("max. common mode voltage"), as long as the differential between any two input pins doesn't exceed 15 V ("max. channel isolation").

The block isolation between the CAN-bus's functional units and the "voltage supply" is defined accordingly.

The concept of block-wise isolation allows relatively large common mode voltages, as long as the maximum voltage differential between the module's channels is not exceeded.



☞ **Important note**:

The contacts *+I* and *-I* of the DSUB-15 connector are exclusively for connecting RTD (PT100) sensors, which have neither a galvanic connection to a different electric potential nor are grounded. These pins are connected with the internal ungrounded module ground *GND_ISO*. Since the ungrounded module is periodically connected with the common mode potentials of the signal sources, grounding these contacts can lead to damage from short circuiting.

On the standard connector:
"+I" = DSUB(9), Terminal K1, "(RES.)"
"–I" = DSUB(6), Terminal K10, "(GND)"

The same applies to the terminals *GND* and *+5V*: with this conditioner type, these contacts are not used for the supply voltage. They are reserved for special functions (cold junction compensation) and remain free!

If one of these pins were to be short circuited, the module's block-wise isolation would be cancelled! This would mean the loss of the measurement input's differential properties and thus of the module's basic functionality. Protection mechanisms prevent module damage in such cases, but instead, apparently "random" measurement errors as well as "mysterious" effects can result!

Two things are critical for undisturbed operation:

- **The module frame must be connected to protection ground in order to achieve effective shielding.**
- **If switching power adapters (e.g. plug power units) are used, the output should be grounded. This will be explained in detail below.**

6.17.8 Isolation of the voltage supply module

The module is supplied with direct current of 9 to 32 V. The internal supply unit is isolated, so that its potential level doesn't have any effect.

(The supply module under discussion here is not to be mistaken for the optional sensor supply! The sensor supply, which is also designated ±*SUPPLY*, is available at the DSUB-15 connectors.)

The block-wise isolation concept enables a substantial (DC-) isolation voltage between the supply unit and the remaining module parts. This is especially important with in-vehicle measurements:

In such set-ups, a electrical connection between the voltage supply and the module frame would create problems. Due to transient and electrostatic charges, considerable potential differentials can develop between the (-) vehicle battery ("grounded" at the contact "CHASSIS1") and the module frame ("grounded" at the contact "CHASSIS2"). This leads to strong compensation currents via the supply cable.

The voltage source is already grounded with the battery; any further grounding via the module is not permitted. For this reason the device's supply block must be isolated.

Conversely, switching power adapters make an additional aspect noticeable:

In spite of their excellent static isolation, electrically isolated devices will inevitably have very small capacitances. These capacitances (the AC/DC adapter's and the internal DC/DC converter's isolation capacitances) make it possible for high-frequency components of the switching power adapter (e.g. 100 kHz, 220 V!) to be coupled in via the input circuitry. The HF-circuit is closed by the signal source, which is either directly galvanically grounded or coupled to ground via leakage capacitances.

This mechanism can increase noise or cause offset errors which accumulate due to non-linear rectification in the input amplifier. This problem is called RF-interference and, depending on the circuit, can be unavoidable with highly sensitive amplifiers having a large bandwidth. The amplifier's quality may limit the problem, but complete RFI immunity can never be achieved. For this reason, it's generally advisable to ground the common mode voltage supply of a switching power adapter.

In cases in which RFI problems occur with switching power adapters whose supply's static isolation voltage potential is already determined and rules out electrical grounding, a large (ceramic) capacitance connected between *SUPPLY* and *CHASSIS* could help! A suitable 1nF capacitor is already present internally and should succeed in suppressing the problems described in most cases!

6.17.9 Filter

The signal passes through the following filter stages one at a time.

1. **Hardware**: Pre-filter for the ADC (analog-digital converter), which works according to the Sigma-Delta procedure and requires a relatively high-frequency, fixed-frequency low-pass filter: Low-pass 60 kHz, 3rd order. This filter cannot be deactivated.
2. **ADC**: Low-pass effect of the ADC itself. Its cutoff frequency is around 8 kHz. Its characteristic is a 3rd order rectangular filter.
3. **Noise suppression**: Noise suppression filter, dependent on the sampling rate. This is a low-pass filter with Hanning characteristics. See the table for the cutoff frequency. The cutoff frequency is far above a channel's sampling frequency. The filter counteracts the aliasing and suppresses noise and disturbances, but not in the sense of a perfect anti-aliasing filter. This filter cannot be deactivated. With some modules and at top sampling rates, this filter stage is omitted.
4. **Compensation:** Compensation filter, dependent upon the sampling rate. This filter adjusts the sampling instant. This compensates for the fact that measurement is based on the use of a multiplexer. The filter returns data which simulate simultaneous sampling on all channels. This filter can be deactivated with the option "Filter / No filter". The filter also is the main cause of delay on the CAN-Bus. It also mainly determines the module's resulting cutoff frequency. The filter has Hamming-characteristics. It is omitted for very slow sampling frequencies.
5. **Averaging**: Formation of a mean value. If the individual channels have different sampling rates, then the multiplexer operates at only one single (high) sampling rate. The channels with slower sampling rates are generated by forming arithmetical means of the sample values, where the measured values from the previous filter stage are averaged over the whole sampling interval. With the option "No filter", this averaging replaces the current value from the previous filter stage. With very slow sampling rates, the value is also generated by taking averages.

Remarks

- The filters are designed so that noise is suppressed as much as possible in spite of the multiplexer on which measurement is based.
- If high-performance anti-aliasing is required, then modules such as C8 and UNI8 with their high-performance analog portions are recommended.
- If interference at mains frequency (50 Hz, 60 Hz) in the measurement of thermocouples (or even the measurement of small voltages in general) is to be suppressed, then a sampling rate must be selected for every channel for which the noise suppression filter's cutoff frequency is a maximum of around 20 Hz. E.g. for the SC16 the sampling rate should be 1s or slower!

The multiplexer's highest switching frequency:

module	max. switching freq. [Hz]	highest recommended sampling frequency [Hz]
SC16	200	100
SCI16	167	50
SCI8	330	100

In the tables above, the *Specified sampling interval* is stated, which is set in the user's interface. In the module itself, a slightly different sampling interval is operative due to the multiplexer and its maximum switching frequency. Nevertheless, you obtain correct data at the desired rate over the CAN-Bus.

6.17.9.1 SC16 Filter

Off: Block averaging but no time offset correction
On: Block averaging but and time offset correction

The sample rate of 5 ms is interpolated. The real sampling time is 6 ms. There is no averaging for sample rate 5 ms and 10 ms.

specified sampling interval	filter cutoff frequency noise suppression stage 3	filter cutoff frequency compensation stage 4	averaging stage 5
2 ms	20000 Hz	28 Hz	
5 ms	20000 Hz	28 Hz	
10 ms	1300 Hz	14 Hz	
20 ms	650 Hz	7 Hz	
50 ms	260 Hz	2,8 Hz	
100 ms	130 Hz	1,4 Hz	
200 ms	65 Hz	0,7 Hz	
500 ms	26 Hz		
1s	13 Hz		
2s	6 Hz		
5s	6 Hz		Yes
10s	6 Hz		Yes
20s	6 Hz		Yes
30s	6 Hz		Yes
60s	6 Hz		Yes

6.17.9.2 SCI16 Filter

Filter settings:

Off: Block averaging but no time offset correction

On: Block averaging but and time offset correction

The sample rate of 5 ms is interpolated. The real sampling time is 6 ms. There is no averaging for sample rate 5 ms and 10 ms.

specified sampling interval	filter cutoff frequency noise suppression stage 3	filter cutoff frequency compensation stage 4	averaging stage 5
2 ms	-	23 Hz	
5 ms	-	23 Hz	
10 ms	-	14 Hz	
20 ms	700 Hz	7 Hz	
50 ms	280 Hz	2,8 Hz	
100 ms	140 Hz	1,4 Hz	
200 ms	70 Hz	0,7 Hz	
500 ms	28 Hz		
1s	14 Hz		
2s	7 Hz		
5s	7 Hz		Yes
10s	7 Hz		Yes
20s	7 Hz		Yes
30s	7 Hz		Yes
60s	7 Hz		Yes

6.17.9.3 SCI8 Filter

Filter setting

Off: Block averaging but no time offset correction

On: Block averaging but and time offset correction

The sample rate of 1 ms is interpolated. The real sampling time is 3 ms. There is no averaging for sample rate 1 ms and 5 ms.

specified sampling interval	filter cutoff frequency Noise suppression stage 3	filter cutoff frequency compensation stage 4	averaging stage 5
1 ms	-	42 Hz	
2 ms	-	42 Hz	
5 ms	-	28 Hz	
10 ms	700 Hz	14 Hz	
20 ms	350 Hz	7 Hz	
50 ms	140 Hz	2,8 Hz	
100 ms	70 Hz	1,4 Hz	
200 ms	35 Hz	0,7 Hz	
500 ms	14 Hz		
1 s	7 Hz		
2 s	3 Hz		Yes
5 s	3 Hz		Yes
10 s	3 Hz		Yes
20 s	3 Hz		Yes
30 s	3 Hz		Yes
60 s	3 Hz		Yes

6.17.10 Delay

	delay time [ms]					
	SC8I		**SCI16**		**SC16**	
sampling time	without filter	with filter	without filter	with filter	without filter	with filter
2 ms	4	6	10	15	12	13
5 ms	5	7	8	14	2	8
10 ms	3	7	7	16	4	15
20 ms	4	25	6	31	8	30
50 ms	11	37	20	38	15	76
100 ms	28	73	43	157	40	160
200 ms	61	150	85	306	75	310
500 ms	121	294	200	200	160	160
1000 ms	250	250	400	400	320	320
2000 ms	500	500	800	800	630	630

With slower sampling times the filter will not always be calculated completely. Therefore delay times may be similar with and without filtering.

The table indicates typical delay times, for the respective most strongly delayed channels.

The SCxx modules possess certain particularities:

- The highest sampling rates can cause longer delay times than slower sampling rates, depending on the system. The cause is the multiplexer on which the module is based. This multiplexer doesn't change channels at the highest clock rate. The reconstruction filter used also causes increased delay. If the delay time is to be short, then you must select sampling rates with sufficiently short delay. This may well be a slower sampling rate. In that case, the higher sampling rates produce finer intermediate values, which however feature delayed processing.
- With a SCxx module, if different sampling rates are used, the overall delay time results as per the following rule:
  - For channels with the highest sampling rate used, the delay time is determined by this sampling rate.
  - For channels with a slower sampling rate, the resulting delay time is that of the fastest sampling time plus the sampling interval which is set.
- With SCxx modules, the delay time depends on the channel. For instance, if Channels 1, 2, 3 and 4 are contained in a message, then Channel 1 was sampled first, then Channel 2 and finally Channel 4. Thus the most current (the newest) measured value in the message comes from Channel 4. Conversely, the measured value from Channel 1 is the most delayed one.

6.18 UNI8

Universal channels - not isolated

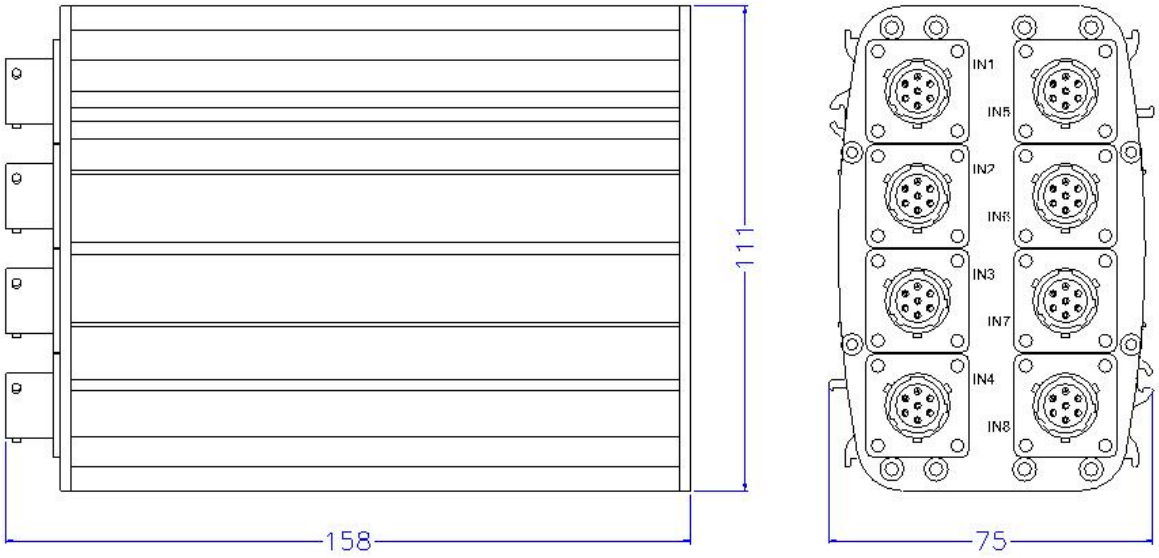
Variety	Properties	Remarks
ITT-VEAM	voltage measurements voltage measurements with adjustable supply current measurement thermocouples thermocouples, isolated* temperature sensor Pt100 bridge-sensor bridge: strain gauge	
LEMOSA		
DSUB 15		
ZF LEMO	voltage measurements voltage measurements with adjustable supply current measurement (differential) thermocouples thermocouples, isolated* temperature sensor Pt100 bridge-sensor (no ¼ bridge) bridge: strain gauge	In this model, the contacts labeled G and E in the circuit diagram are committed. Thus, the following functions are no longer available: sensor recognition ¼ bridge completion and measurement thermocouples with Pt100 in connector 3-wire Pt100 measurement single ended current measurement sensors with current signal

*the thermocouple has no low-impedance connection to the device ground.

Technical data UNI8. 418

CANSAS-L-UNI8 ITT-VEAM Signalseite

CANSAS-L-UNI8 ITT-VEAM CAN-Anschluss



CANSAS-L-UNI8ITT-VEAM

To supply external sensors or bridges the module is equipped with a sensor supply module 347.

Supports TEDS 199 (Transducer Electronic Data Sheets (IEEE 1451)

The measurement inputs whose terminals are DSUB plugs (ACC/DSUB-UN2 445) are for voltage, current, bridge PT-100 and thermocouple measurements. They are **non-isolated differential amplifiers**. They share a common voltage supply for sensors and measurement bridges.

6.18.1 Voltage measurement

- Voltage: ±50 V to ±5 mV; DSUB-plug: ACC/DSUB-UNI2

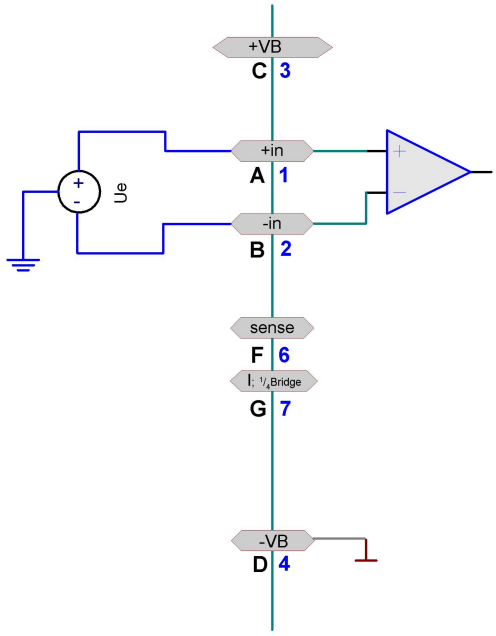
Within the voltage ranges ±50 V and ±20 V, a voltage divider is in effect; the resulting input impedance is 1 MΩ.

By contrast, in the voltage ranges ±10 V and ±5 mV, the input impedance is 20 MΩ. For the deactivated device, the value is approx. 1 MΩ.

In the input ranges <20 V, the common mode voltage* must lie within the ±10 V range. The range is reduced by half of the input voltage. The input configuration is differential and DC-coupled.

**The common mode voltage is the arithmetic mean of the voltages at the inputs +IN and -IN, referenced to the device ground. For instance, if the potential to ground is +10 V at +IN and +8 V at -IN, the common mode voltage is +9 V.*

6.18.1.1 Voltage source with ground reference



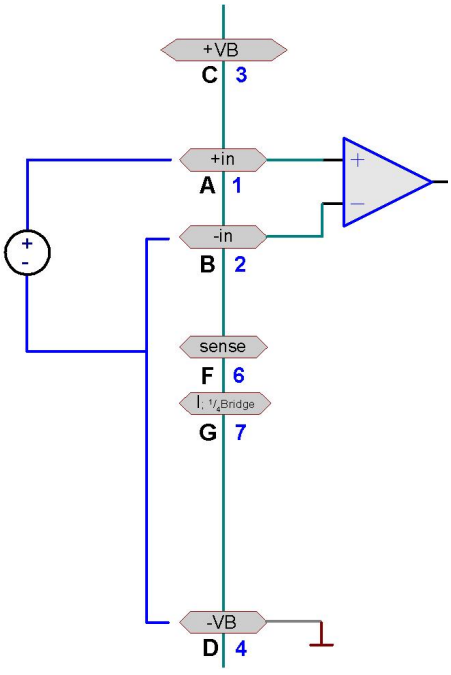
The voltage source itself already has a connection to the device's ground. The potential difference between the voltage source and the device ground must be fixed.

Example: The device is grounded. Thus, the input -*VB*(D) is also at ground potential. If the voltage source itself is also grounded, it's referenced to the device ground. It doesn't matter if the ground potential at the voltage source is slightly different from that of the device itself. But the maximum allowed common mode voltage must not be exceeded.

Important: In this case, the negative signal input -*in*(B) may not be connected with the device ground -*VB*(D). Connecting them would cause a ground loop through which interference could be coupled in.

In this case, a genuine differential (but not isolated!) measurement is carried out.

6.18.1.2 Voltage source without ground reference

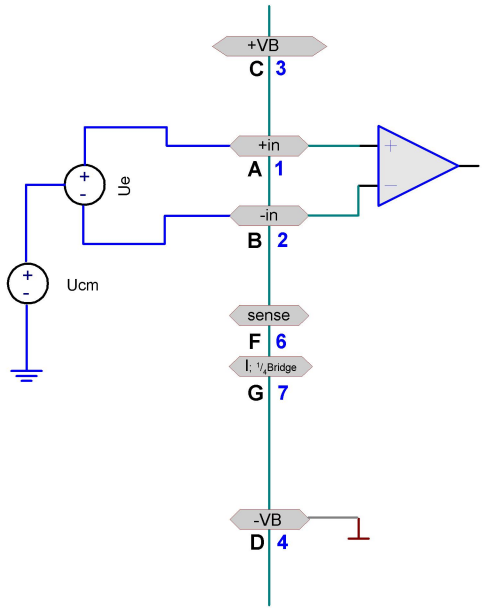


The voltage source itself is not referenced to the amplifier ground but is instead isolated from it. In this case, a ground reference must be established. One way to do this is to ground the voltage source itself. Then it is possible to proceed as for Voltage source with ground reference 335. Here, too, the measurement is differential. It is also possible to make a connection between the negative signal input and the device ground, in other words to connect -*in*(B) and -*VB*(D).

Example: An ungrounded voltage source is measured, for instance a battery whose contacts have no connection to ground. The device module is grounded.

Important: If -*in*(B) and -*VB*(D) are connected, care must be taken that the potential difference between the signal source and the device doesn't cause a significant compensation current. If the source's potential can't be adjusted (because it has a fixed, overlooked reference), there is a danger of damaging or destroying the amplifier. If -*in*(B) and -*VB*(D) are connected, then in practice a single-end measurement is performed. This is no problem if there was no ground reference beforehand.

6.18.1.3 Voltage source at a different fixed potential



The common mode voltage (U_{cm}) has to be less than ±10 V. It is reduced by ½ input voltage.

Example: Suppose a voltage source is to be measured which is at a potential of 120 V to ground. The system itself is grounded. Since the common mode voltage is greater than permitted, measurement is not possible. Also, the input voltage difference to the amplifier ground would be above the upper limit allowed. For such a task, the *UNI8*cannot be used!

6.18.1.4 Voltage measurement: with zero-adjusting (tare)

In voltage measurement, it is possible for the sensor to have an initial offset from zero. For such cases, use the operating software to select the measurement mode "*Voltage enable offset calibration*" for the desired channel. The input range will be reduced by the initial offset. If the initial offset is too large for compensation by the device, a larger input range must be set.

Measurement range [V]	Compensable initial offset* [V]		Measurement range [V]	Compensable initial offset* [V]
±50	8.4		±0,5	0.08
±20	38.4		±0,2	0.3
±10	1.6		±0,1	0.015
±5	6.5		±0,05	0.06
±2	0.9		±0,02	0.008
±1	1.9		±0,01	0.018
			±0,005	0.023

*The maximum initial unbalance is the difference between the input range set and the possible input range. For instance, if the actual range for a setting of 50 V and of 20 V is 58.4 V, then the resulting possible initial unbalance is 8.4 V in the 50 V input range and 38.4 V in the 20 V input range.

For notes on triggering the adjustment, refer to the section on bridge measurement 339.

6.18.2 Bridge measurement

Measurement of **measurement bridges** such as strain gauges.

The measurement channels have an adjustable DC voltage source which supplies the measurement bridges. The supply voltage for a group eight inputs is set in common. The bridge supply is asymmetric, e.g., for a bridge voltage setting of $V_B = 5$ V, Pin +*VB* (C) is at +VB =5 V and Pin -*VB* (D) at -VB =0 V. The terminal –VB is simultaneously the device's ground reference.

Per default 5 V and 10 V can be selected as bridge supply. Depending on the supply set, the following **input ranges** are available:

Bridge voltage [V]	Measurement range [mV/V]
10	±1000 to ± 0.5
5	±1000 to ± 1

Fundamentally, the following holds: For equal physical modulation of the sensor, the higher the selected bridge supply is, the higher are the absolute voltage signals the sensor emits and thus the measurement's **signal-to-noise ratio** and drift quality. The limits for this are determined by the maximum available current from the source and by the **dissipation** in the sensor (temperature drift!) and in the device (power consumption!)

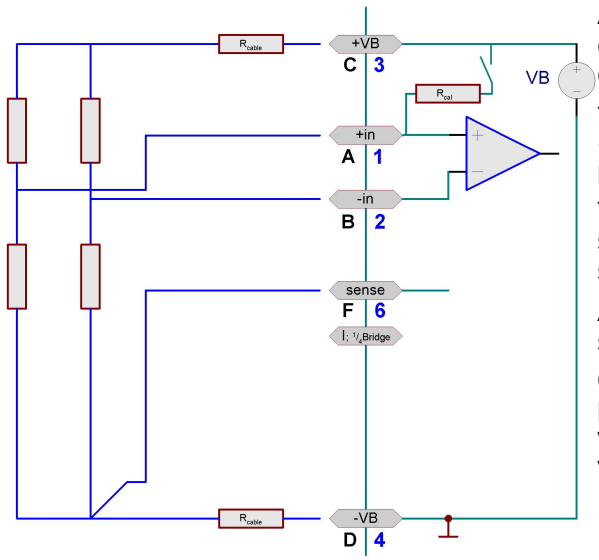
- For typical measurements with **strain gauges**, the ranges 5 mV/V to 1 mV/V are particularly relevant.
- There is a maximum voltage which the **Potentiometer** sensors are able to return, in other words max. 1 V/V; a typical range is then 1000 mV/V.

Bridge measurement is set by selecting as measurement mode either *Bridge: Sensor* or *Bridge: Strain gauge* in the operating software. The bridge circuit itself is then specified under the tab *Bridge circuit*, where quarter bridge, half bridge and full bridge are the available choices.

Note

We recommend setting channels which are not connected for voltage measurement at the highest input range. Otherwise, if unconnected channels are in quarter- or half-bridge mode, interference may occur in a shunt calibration!

6.18.2.1 Full bridge



A full bridge has four resistors, which can be four correspondingly configured strain gauges or one complete sensor which is a full sensor internally.

The full bridge has five terminals to connect. Two leads +*VB*(C) and -*VB*(D) serve supply purposes, two other leads +*in* (A) and -*in*(B) capture the differential voltage. The 5th lead *sense*(F) is the Sense lead for the lower supply terminal, which is used to determine the single-sided voltage drop along the supply line.

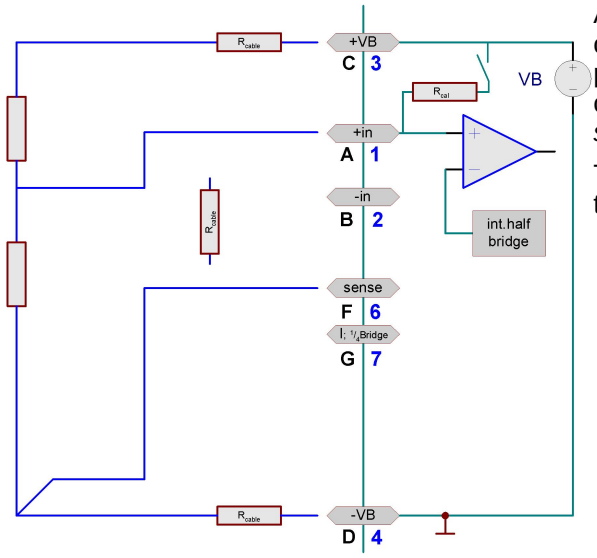
Assuming that the other supply cable +*VB* (C) has the same impedance and thus produces the same voltage drop, no 6th lead is needed. The Sense lead makes it possible to infer the measurement bridge's true supply voltage, in order to obtain a very exact measurement value in mV/V.

Please note that the maximum allowed voltage drop along a cable may not exceed approx. 0.5 V. This determines the maximum possible cable length.

If the cable is so short and its cross section so large that the voltage drop along the supply lead is

negligible, the bridge can be connected at four terminals by omitting the Sense line.

6.18.2.2 Half bridge



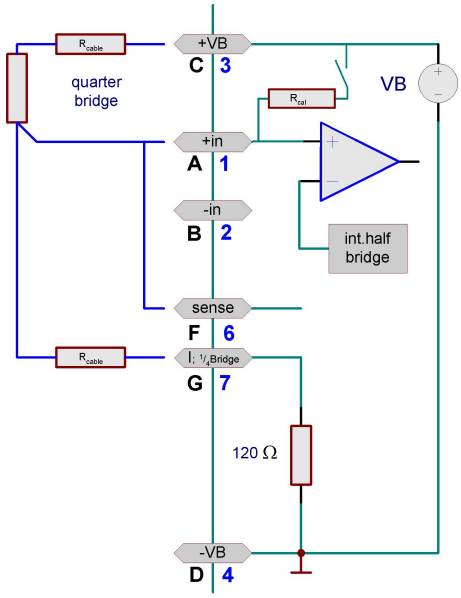
A half bridge may consist of two strain gauges in a circuit or a sensor internally configured as a half bridge, or a potentiometer sensor. The half bridge has 4 terminals to connect. For information on the effect and use of the *sense* (F) lead, see the description of the full bridge 337.

The amplifier internally completes the full bridge itself, so that the differential amplifier is wor.king with a full bridge.

Note

It is important that the measurement signal of the half bridge is connected to *+IN* (A). The *IN* (B) access leads to implausible measured values and influences the neighbor channels.

6.18.2.3 Quarter bridge



A quarter bridge can consist of a single strain gauge resistor. *UNI8* internally completes an additional 120 Ω that can be switched to a 350 Ω quarter bridge.

For quarter bridge measurement, only 5 V can be set as the bridge supply.

The quarter bridge has 3 terminals to connect. Refer to the description of the full bridge for comments on the Sense lead. However, with the quarter bridge, the Sense lead is connected to *+in*(A) and *sense*(F) jointly.

If the sensor supply is equipped with the option “±15 V”, a quarter bridge measurement is not possible. The pin *I_1/4B* for the quarter bridge completion is used for –15 V instead.

Note

By default comes with a 120 Ω internal bridge completion resistor. A 350 Ω completion resistor is alternatively possible for the purpose of quarter bridge measurement. When using this option, the scope of available functions is limited:

- No direct current measurement 341 with the standard included connector ACC/DSUB-UNI2 is possible, but only with the optional ACC/DSUB-I2 connector with a 50 Ω shunt resistor (differential measurement).

6.18.2.4 Sense and initial unbalance

The ***SENSE*** lead serves to compensate voltage drops due to cable resistance, which would otherwise produce noticeable measurement errors. If there are no sense lines, then *UNI8* ***SENSE*** (F) **must be connected** in the terminal plug according to the sketches above.

Bridge measurements are relative measurements (**ratiometric procedure**) in which the fraction of the bridge supply fed in which the bridge puts out is analyzed (typically in the 0.1 % range, corresponding to 1 mV/V). Calibration of the system in this case pertains to this ratio, the bridge input range, and takes into account the momentary magnitude of the supply. This means that the **bridge supply's actual magnitude is not relevant** and need not necessarily lie within the measurement's specified overall accuracy.

The bandwidth (without lowpass filter) is for DC-bridge measurement 200 Hz, too.

Any **initial unbalance** of the measurement bridge, for instance due to mechanical pre-stressing of the strain gauge in its rest state, must be zero-balanced. Such an unbalance can be many times the input range (bridge balancing). If the initial unbalance is too large to be compensated by the device, a larger input range must be set.

Possible initial unbalance

input range [mV/V]	bridge balancing (VB = 2.5 V) [mV/V]	bridge balancing (VB = 5 V) [mV/V]	bridge balancing (VB = 10 V) [mV/V]
±1000	200	500	150
±500	200	100	250
±200	30	100	50
±100	30	15	50
±50	6	15	7
±20	20	3	7
±10	20	10	15
±5	7	10	5
±2	9	3	5
±1	-	4	5
±0.5	-	-	-

6.18.2.5 Balancing and shunt calibration

The amplifier offers a variety of possibilities to trigger bridge balancing:

- Balancing / shunt calibration upon activation (cold start) of the unit. If this option is selected, all the bridge channels are balanced as soon as the device is turned on.
- Balancing / shunt calibration via the CAN-Bus. Select the CAN-message ID on the *Balance tab*.
  - The message's 4th bit must be "1" (0x10) in order to trigger balancing.
  - The message's 5th bit must be "1" (0x20) in order to trigger shunt calibration.
- Balancing / shunt triggered by the button: CANSAS-UNI8's button can be used to initiate balancing of all bridge channels. For this purpose, the button's function must be specified on the *General*-tab as *Activate balance*.
- It is possible to perform balancing / shunt in the *Measure*-window belonging to the CANSAS configuration software for each bridge channel separately. The channels to be balanced must be selected.
- In shunt calibration, the bridge is unbalanced by means of a 174.7 kΩ shunt (between *+VB* and *+IN*). The results are:

Bridge resistance	120 Ω	350 Ω
174.7 kΩ	0.171 mV/V	0.5005 mV/V

The procedures for balancing bridge channels also apply analogously to the voltage measurement mode with zero-balancing.

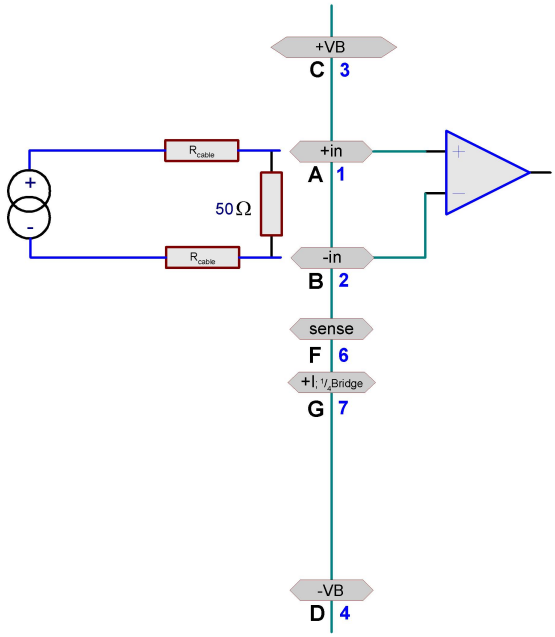
Note

- We recommend setting channels which are not connected for voltage measurement at the highest input range. Otherwise, if unconnected channels are in quarter- or half-bridge mode, interference may occur in a shunt calibration!
- If you use an imc measurement device to measure, see application notes in chapter *Field Busses* of the *imcDevices* manual. There are examples how to use *imc Devices*- and *CANSAS*-software step by step. Owner of a µ-Musycs can get an extract upon request.
- Shunt calibrations are a special case: If at least one channel is set to *Voltage, allow zero-balance* and no channel is set for bridge or strain gauge measurement, then upon activation of a shunt calibration, both the status bar and the function *Output status on LED* will indicate a shunt calibration, but none will be carried out. Conversely, if balancing is set, it will be indicated and carried out, too, upon activation.
- **Note that importing a changed configuration to the module deletes any previously performed bridge balancing and resets it to zero. Therefore, always repeat bridge balancing after importing a configuration!**

6.18.3 Current measurement

6.18.3.1 Differential current measurement

Current: ±50 mA to ±1 mA



For current measurement could be used the DSUB plug ACC/DSUB-I2. That connector comes with a 50 Ω shunt and is not included with the standard package. It is also possible to measure a voltage via an externally connected shunt. Appropriate scaling must be set in the user interface. The value 50 Ω is just a suggestion. The resistor needs an adequate level of precision. Pay attention to the shunt's power consumption.

The **maximum common mode voltage** must be in the range **±10 V** for this circuit, too. This can generally only be ensured if the current source itself already is referenced to ground. If the current source is ungrounded a danger exists of exceeding the maximum allowed overvoltage for the amplifier. The current source may need to be referenced to the ground, for example by being grounded.

The sensor can also be supplied with a software-specified voltage via Pins *+VB*(C) and *-VB*(D).

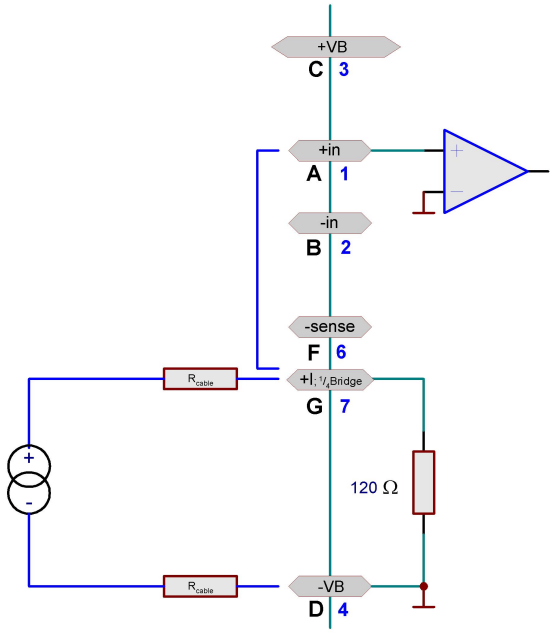
Note

Since this procedure is a voltage measurement at the shunt resistor, voltage measurement must also be set in the *imcDevices* interface.

The scaling factor is entered as 1/R and the unit as A (0.02 A/V = 1/50 Ω).

6.18.3.2 Ground-referenced current measurement

- Current: ±50 mA to ±2 mA



In this circuit, the current to be measured flows through the 120 Ω shunt in the amplifier. Note that here, the terminal -*VB*(D) is simultaneously the device's ground. Thus, the measurement carried out is single-end or ground referenced. The potential of the current source itself may be brought into line with that of the units ground. In that case, be sure that the device unit itself is grounded.

In the settings interface, set the measurement mode to *Current*.

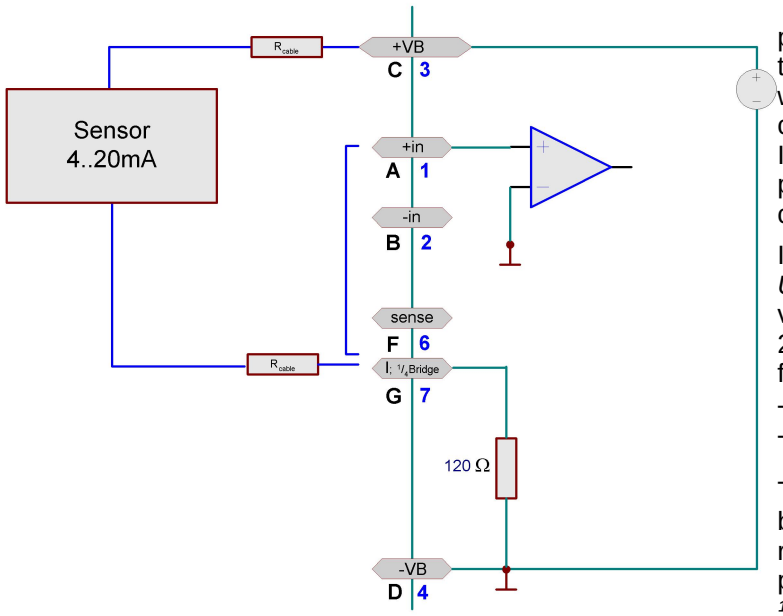
Note that the jumper between +*IN*(A) and +*I; ¼Bridge*(G) should be connected right inside the connector.

Notes

- For an (optional) sensor supply with ±15 V ground referenced current measurement is not possible. The pin *I;¼Bridge* is used as –15 V pin.
- For the former *UNI8* equipped with a 350 Ω quarter bridge completion, ground referenced current measurement is not possible!

6.18.3.3 2-wire for sensors with a current signal and variable supply

- E.g. for pressure transducers 4 mA to 20 mA.



Transducers which translate the physical measurement quantity into their own current consumption and which allow variable supply voltages can be configured in a two-wire circuit. In this case, the device has its own power supply and measures the current signal.

In the settings dialog on the index card *Universal amplifiers / General*, a supply voltage is set for the sensors, usually 24 V. The channels must be configured for *Current measurement*.

The sensor is supplied with power via Terminals +*VB(C)* and +*I; ¼Bridge*(G)

The signal is measured by the unit between +*IN(A)* and -*VB*(D). For this reason, a wire jumper must be positioned between Pins +*IN*(A) and +*I; ¼Bridge*(G) inside the connector pod.

Note

- There is a voltage drop across the resistances of the leadwires and the internal measuring resistance

of 120 Ω which is proportional to the amperage. This lost voltage is no longer available for the supply of the transducer (2.4 V = 120 Ω * 20 mA). For this reason, you must ensure that the resulting supply voltage is sufficient. It may be necessary to select a leadwire with a large enough cross-section.

- For the former *UNI8:* If the amplifier is equipped with a 350 Ω quarter bridge completion, ground referenced current measurement is not possible! Thus this operation is not possible, too.

6.18.4 Temperature measurement

The amplifier channels are designed for direct measurement with **thermocouples and Pt100**-sensors. **Any combinations** of the two sensor types can be connected.

6.18.4.1 Thermocouple measurement

The cold junction compensation necessary for thermocouple measurement is built-in. For this purpose, UNI8 comes with the appropriate Pt1000 resistors for measuring the junction temperature. Note, however, that these resistors are not installed in the plugs themselves but on the housing, so that they are actually at some distance from the real contact point. This point's exact location is where the thermo-wires meet the electric contacts in the plug, basically where they are soldered or crimped. Since the temperature sensor Pt1000 and the contact point are separated in space, their temperatures can also diverge. This temperature difference can also lead to measurement errors. However, situations do exist where the measurement results are valid; for example, inside a switch cabinet where the temperature processes are stabilized, the internal cold junction compensation is in practice adequate.

With CANSAS-SL-UNI8-L having LEMO terminals, thermocouple measurement requires a specially designed cable from imc equipped with a built-in Pt100 temperature sensor. The connection is then made in the same way as with the model without a Pt100 inside of the connector.

However, if the temperature processes in CANSAS' environment are not stable, a Pt100 in the connector is absolutely necessary. This is certainly the case if there is a draught, if the module is used on-board a vehicle, if cables with terminals of different temperature are connected, if the ambient temperature is fluctuating or, when in doubt, whenever reliable and precise measurement is required.

The following circuit diagrams reflect each of the varieties with and without Pt100 in the connector.

We strongly recommend using a Pt100 in the connector for all thermocouple measurements.

All common thermocouple types with their characteristic curves are supported. However, it is only possible to measure with multiple thermocouples at the same time if they are all of the same type. Thus, all channels set to Type K will work, but not 1 channel Type K and one channel Type J won't. A combination of thermocouple measurement and Pt100 measurement, by contrast, is possible.

For connection with **ITT VEAM** plugs, the module comes with the appropriate Pt1000 resistors for measuring the junction temperature. Note, however, that these resistors are not installed in the plugs themselves but on the housing, so that they are actually at some distance from the real contact point. This point's exact location is where the thermo-wires meet the electric contacts in the plug, basically where they are soldered or crimped. Since the temperature sensor Pt1000 and the contact point are separated in space, their temperatures can also diverge. This temperature difference can also lead to measurement errors. However, situations do exist where the measurement results are valid; for example, inside a switch cabinet where the temperature processes are stabilized, the internal cold junction compensation is in practice adequate.

Using a **LEMO** connector the thermocouple measurement can only be measured with an external Pt100 in the connector, for example the TH-LEM-150.

- However, if the temperature processes in the device’s environment are not stable, a **Pt100 in the connector** is absolutely necessary. This is certainly the case if:
  - there is a draught
  - if the module is used on-board a vehicle
  - if cables with terminals of different temperature are connected
  - if the ambient temperature is fluctuating
  - whenever reliable and precise measurement is required.

The following circuit diagrams reflect each of the varieties with and without Pt100 in the connector. We

strongly recommend using a Pt100 in the connector for all thermocouple measurements.

Note

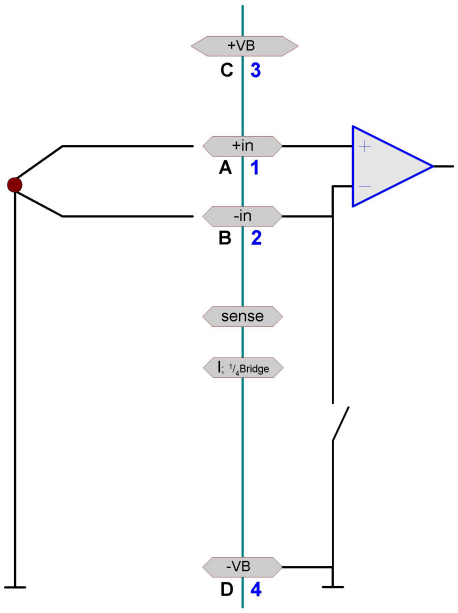
- A description of the available thermocouples 179.

6.18.4.1.1 Thermocouple mounted with ground reference

The thermocouple is mounted in such a way that it already is in electrical contact with the device ground / chassis.

This is ensured by attaching the thermocouple to a grounded metal body, for instance. The thermocouple is connected for differential measurement. Since the unit is grounded itself, the necessary ground reference exists.

In the CANSAS operating software, select the measurement mode **"*Thermocouple (mounted with ground reference)*".**



Thermocouple measurement with ground reference

It is not a problem if the ground potential at the thermocouple differs from that of the device units by a few volts. However, the maximum allowed common mode voltage may not be exceeded.

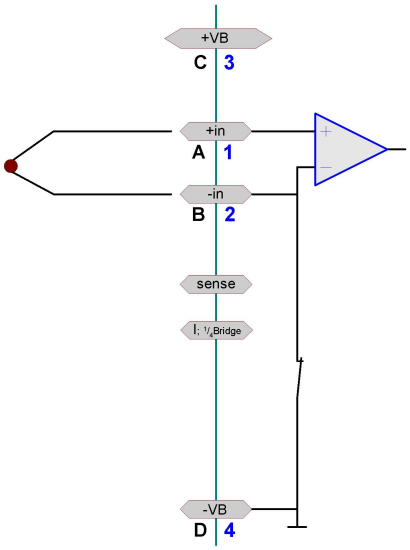
Important Note

- The negative signal input *-IN* may not be connected to amplifier ground point *-VB*(D). Connecting them would cause a ground loop through which interference could be coupled in.
- If you accidentally select the operating mode **"*Thermocouple (mounted without ground reference)*"**, there is a danger that a large compensation current will flow through the thermocouple's (thin) line and the connector plug. This can even lead to the destruction of the amplifier. Compensation currents are a danger with every single end measurement. For that reason, single end measurement is really only allowed -and only then really necessary- if the thermocouple has no ground reference of its own.

6.18.4.1.2 Thermocouple mounted without ground reference

The thermocouple is installed with electrical isolation from the device's Ground / Chassis and is therefore not connected with the device's ground. This is achieved by, among other techniques, having the thermocouple adhere to non-conducting material. As a result, the thermocouple's voltage floats freely against the amplifier ground voltage.

In this case, the amplifier must provide the necessary ground potential.



Thermocouple measurement without ground reference

In the CANSAS operating software, select the measurement mode **"*Thermocouple (mounted without ground reference)*".**

In this measurement mode, the UNI8 unit itself provides the ground reference by having Terminals B and D connected **internally**. Then a measurement which is practically single-ended (ground-referenced) is performed. There is no disadvantage to this if there was no ground reference previously.

Important: The thermocouple itself **may not be ground referenced!**

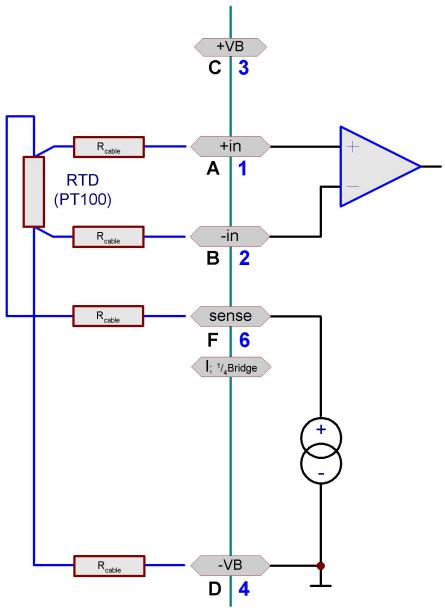
If it was mounted with a ground reference, there is a danger that a large compensation current will flow through the thermocouple's (thin) line and the connector plug. This can even lead to the destruction of the amplifier. Compensation currents are a danger with every single end measurement. For that reason, single end measurement is really only allowed -and only then really necessary- if the thermocouple has no ground reference of its own.

6.18.4.2 Pt100/ RTD measurement

- DSUB-plug: ACC/DSUB-UNI2 445

Pt100. RTD, platinum resistor thermometer. Along with thermocouples, **Pt100** can be connected directly in **4-wire-configuration**. The 4-wire measurement returns more precisely results since it does not require the resistances of both leads which carry supply current to have the same magnitude and drift. Each sensor is fed by its own current source with approx. 1.2 mA.

6.18.4.2.1 Pt100 in 4-wire configuration



The Pt100 is supplied by 2 lines. The other two serve as Sense-leads. By using the Sense-leads, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

The Sense-leads carry practically no current.

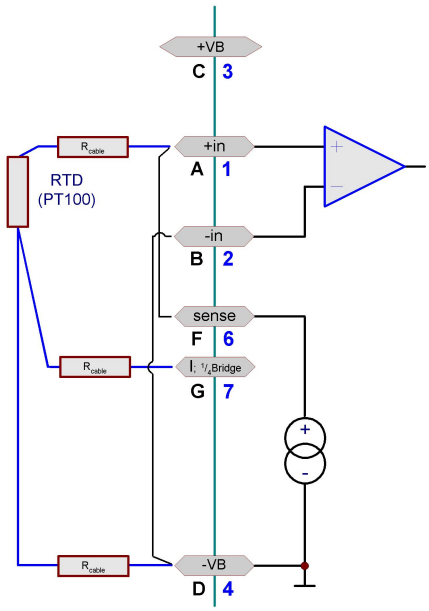
The 4-wire configuration is the most precise way to measure with a Pt100. The module performs a genuine differential measurement.

6.18.4.2.2 Pt100 in 2-wire configuration

Use the software to set a Pt100 4-wire configuration, because the connection is made in the same way as for the 4-wire case. The difference is that *+IN(A)/sense(F)* and *–IN(B)/-VB(D)* must be jumpered inside the connector.

Note that the total **cable resistance** contributes to **measurement error**, and that this method is the most imprecise and not to be recommended.

6.18.4.2.3 Pt100 in 3-wire configuration



The Pt100 is supplied by 2 lines. The other one serve as sense-lead. By using the Sense-lead, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

The sense-lead (here pin G) carrys practically no current.

It is important, that the connection between +*IN*(A) to Sense and -*IN*(B) to -*VB*(D) is made directly at the module.

3-wire configuration is not always as precise as 4-wire configuration. When in doubt, 4-wire configuration is preferable.

6.18.4.3 Probe-breakage recognition

The amplifier comes with the ability of probe-breakage recognition.

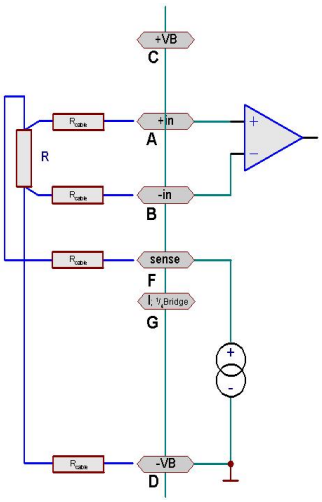
Thermocouple: If at least one of the thermocouple's two lines breaks, then within a short time (only a few samples), the measurement signal generated by the amplifier approaches the bottom of the input range in a defined pattern. The actual value reached depends on the particular thermocouple. In the case of Type K thermocouples, this is around 270°C. If the system is monitoring a cutoff level with a certain tolerance, e.g. Is the measured value <-265°C, then it's possible to conclude that the probe is broken, unless such temperatures could really occur at the measurement location.

The probe-breakage recognition is also triggered if a channel is parameterized for "Thermocouple" and measurement starts without any thermocouple being connected. If a thermocouple is later connected after all, it would take the period of a few measurement samples for transients in the module's filter to subside and the correct temperature to be indicated. Note also in this context that any thermocouple cable's connector which is recently plugged into the amplifier is unlikely to be at the same temperature as the module. Once the connection is made, the temperatures begin to assimilate. Within this phase, the Pt100 built into the connector may not be able to indicate the real junction temperature exactly. This usually takes some minutes to happen.

RTD/Pt100: If the leads to the Pt100 are broken, then within a short time (only a few samples), the measurement signal generated by the amplifier approaches the bottom of the input range, to about 200°C, in a defined pattern. If the system is monitoring a cutoff level with a certain tolerance, e.g. Is the measured value <-195°C, then it's possible to conclude that the probe is broken, unless such temperatures could really occur at the measurement location. In case of a short-circuit, the nominal value returned is also that low.

In this context, note that in a 4-wire measurement a large variety of combinations of broken and shorted leads are possible. Many of these combinations, especially ones with a broken Sense lead, will not return the default value stated.

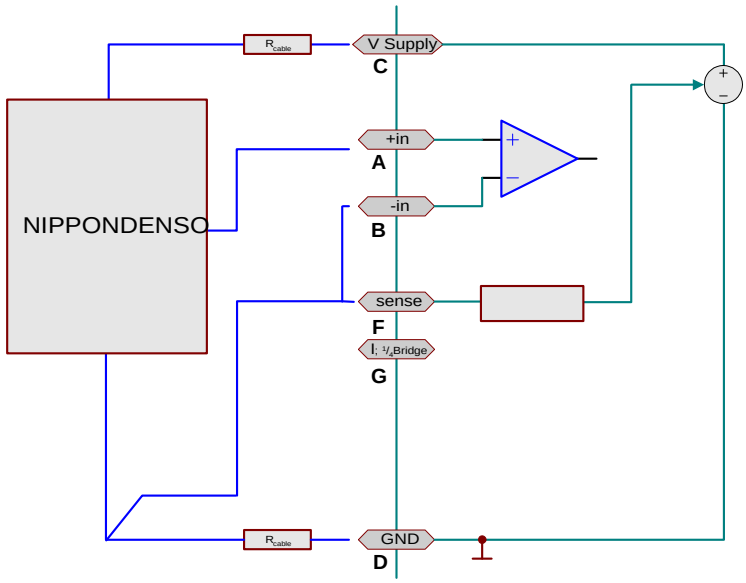
6.18.5 Resistance measurement



For resistance measurement there is only one input range: 0 Ω to 800 Ω. Each resistor is fed by a separate current source with approx. 1.2 mA. The measurement uses 4-wire configuration.

The resistor is supplied by 2 lines. The other two lines serve as sense-leads. By using the Sense-leads, the voltage at the resistor itself can be determined precisely. The voltage drop along the conducting cable thus does not cause any measurement error.

6.18.6 Sensors requiring adjustment of their supply



e.g. for Nippondenso pressure sensors

This applies especially to Nippondenso pressure sensors, for instance.

If a sensor's supply must not be susceptible to voltage drop along the supply cable, it can be adjusted by the device. The option *Adjust control as per:* in the settings interface's dialog *Universal amplifiers / General* must be selected.

If the resistors in the feed lines are equal, the supply voltage is adjusted at the sensor– the voltage drop along the cable is compensated.

The sensor is supplied via Terminals C and D. The sensor returns the measurement signal in reference to its own ground.

UNI8 makes a differential measurement of the signal between A and B.

Note that there must be a jumper between Pins B and F. Pin F is the Sense connection. It serves to measure the voltage drop at the lower voltage feed line.

Adjustment can only be activated for either 5 V or 10 V supply. It can only compensate up to 0.5 V for the supply and return lines together. This means that UNI8's internal voltage source can deliver a maximum of 0.5 V more voltage.
Adjustment works slowly (with a time constant of some seconds) in order to compensate a static voltage drop.

6.18.7 Sensor supply module

UNI8 channels are enhanced with a sensor supply unit, which provides an adjustable supply voltage for active sensors. The reference potential, in other words the sensor's supply ground contact, is the terminal GND.

The supply voltage can only be set for all measurement inputs per module.

The supply outputs are electronically protected internally against short circuiting to ground. The reference - potential, in other words the sensor's supply ground contact, is the terminal GND.

The supply voltage can only be set for all measurement inputs in common. The voltage selected is also the supply for the measurement bridges. If a value other than 5V or 10V is set, bridge measurement is no longer possible!

Note

- Before a sensor will be connected, make sure the voltage supply has been set correctly (not too high). Therefore the voltage supply must be set and configured using the software. Then the sensor can be connected. Otherwise the sensor and the CANSAS-module could be damaged.
- There is a 5 V pin at the imc connector. That voltage is not available for the CANSAS-modules, only for the imc CRONOS-series!

The technical data of the sensor supply is listed in the data sheet of the 418CANSAS-UNI8.

6.18.8 Bandwidth

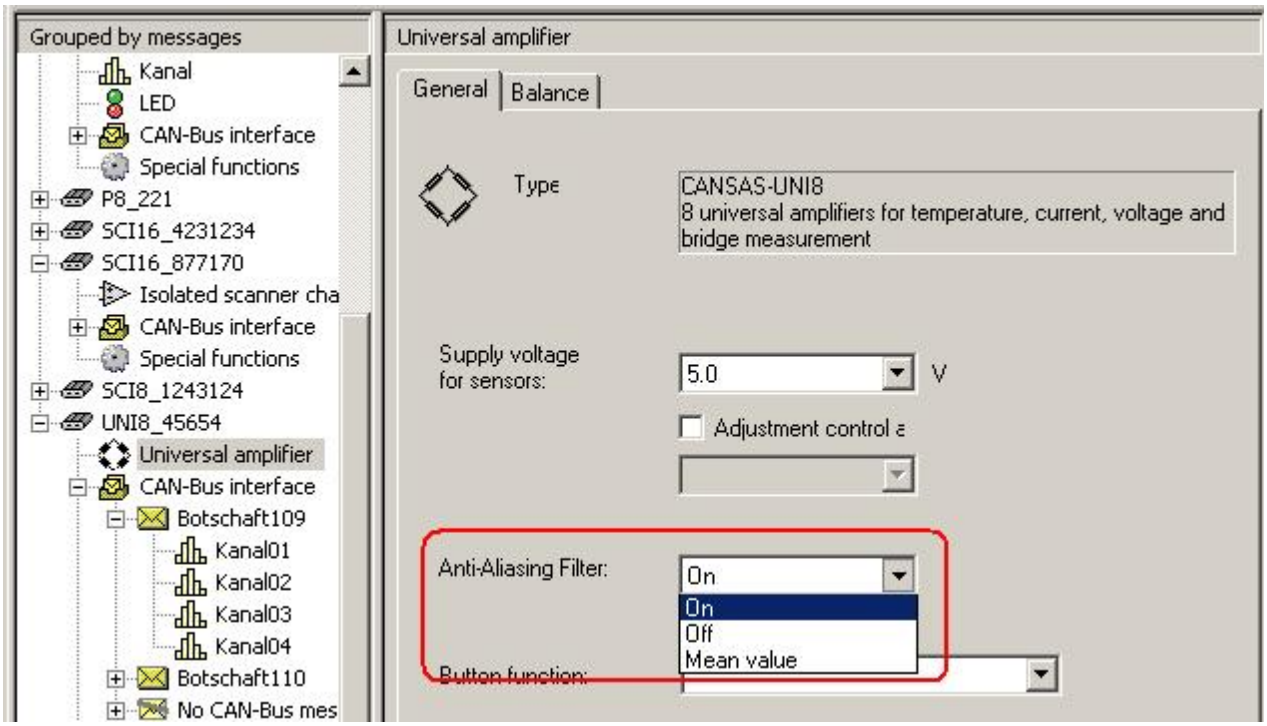
The channels' **maximum sampling rate** is 1 kHz(1 ms).

The **analog bandwidth** (without digital low-pass filtering) is 200 Hz

6.18.9 Sampling intervals, filters and anti-aliasing

For each of the 8 channels, the sampling interval can be freely set to between 1 ms an 60 s. UNI8 come with a hardware-based, permanent anti-aliasing filter (AAF), an analog-digital-converter (ADC) using the sigma-delta method, and finally a digital low-pass filter adapted to the sampling rate.

The hardware-based AAF is suitable for the 1 ms input frequency. The digital low-pass filter is set to the sampling rate and can be switched off on the card *General* of the *UNI8*. Alternatively to the digital AAF it is possible to avoid noise simply by averaging through processing *arithmetic mean* function.



On: Additional digital low-pass filter.
Off: Switch off the digital low-pass filter. The analog anti-aliasing filter takes always effect.
Mean value: The output value is averaged by (Sampling interval[ms] / 1 ms) samples.

The table below shows which resulting filter is used.
For temperature measurement (Pt100 and thermocouples):

Sampling rate	Filter
1 ms	Critical damping, 4th order, cutoff frequency 120 Hz
2 ms	Critical damping, 4th order, cutoff frequency 60 Hz
5 ms	Critical damping, 4th order, cutoff frequency 25 Hz
10 ms	Critical damping, 4th order, cutoff frequency 12 Hz
20 ms	Critical damping, 4th order, cutoff frequency 6 Hz
50 ms	Critical damping, 4th order, cutoff frequency 2 Hz
100 ms	Critical damping, 4th order, cutoff frequency 1 Hz
200 ms	Critical damping, 4th order, cutoff frequency 0.5 Hz
500 ms	Critical damping, 4th order, cutoff frequency 0.2 Hz
1 s	Critical damping, 4th order, cutoff frequency 0.1 Hz
2 s to 60 s	Arithmet. mean over the duration of the sampling interval of values sampled at 1 kHz

All other measurement types (voltage, current, bridges and resistance):

Sampling rate	Filter
1 ms	Butterworth, 2nd order, cutoff frequency 220 Hz
2 ms	Butterworth, 2nd order, cutoff frequency 110 Hz
5 ms	Butterworth, 2nd order, cutoff frequency 40 Hz
10 ms	Butterworth, 2nd order, cutoff frequency 20 Hz
20 ms	Butterworth, 2nd order, cutoff frequency 10 Hz
50 ms	Butterworth, 2nd orderder, cutoff frequency 4 Hz
100 ms	Butterworth, 2nd order, cutoff frequency 2 Hz
200 ms	Butterworth, 2nd order, cutoff frequency 1 Hz
500 ms	Butterworth, 2nd order, cutoff frequency 0.4 Hz
1 s	Butterworth, 2nd order, cutoff frequency 0.2 Hz
2 s to 60 s	Arithmet. mean over the duration of the sampling interval of values sampled at 1 kHz

The filters are optimized to provide good suppression of interference while causing only insubstantial signal surges in the time domain and only minor delay times. Note that the filters selected are not perfect anti-aliasing filters (e.g. with damping of 96 dB at one-half of the sampling frequency).

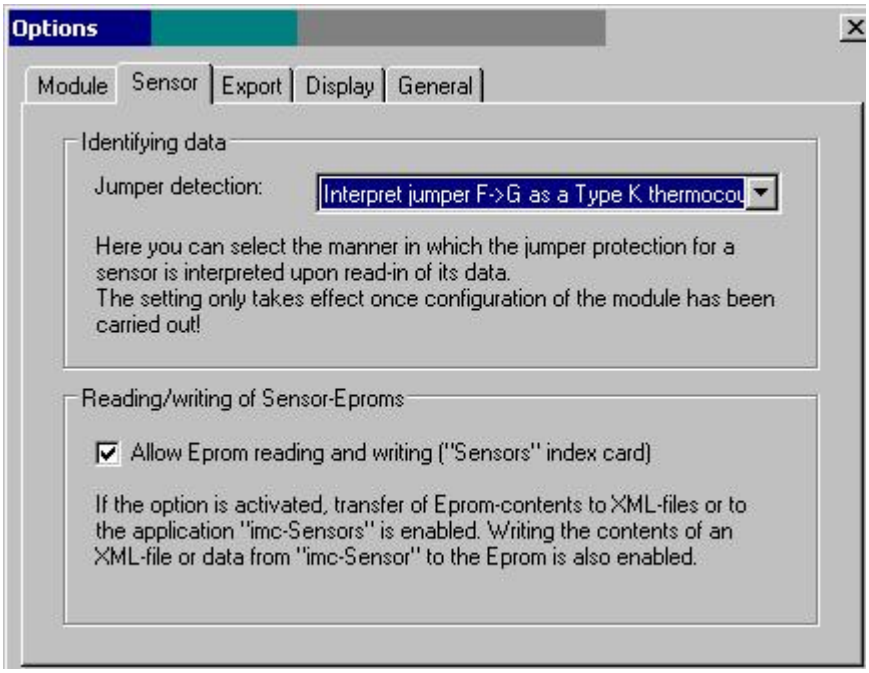
If you use a sampling interval other than 1 ms and the default filter is not suited to your measurement requirements, simply select 1 ms as the sampling interval and then arrange the appropriate low-pass filtering or averaging by means of a virtual channel.

6.18.10 Recognition of sensor by means of wire jumpers

Besides the convenient sensor recognition capability provided by an EPROM (TEDS), there is also the possibility to use wire jumpers to broadly specify the sensor type. However, only a thermocouple of type K can be unambiguously recognized in this way. This option must be set globally in the CANSAS software.

Go to the menu item Extras ⇒ Options… ⇒ Sensor and select under Identifying data ⇒ *Interpret jumper F-G as a Type K thermocouple.*

The UNI8 unit will enter a Type K thermocouple as connected in the configuration:


Options
Module
Sensor
Export
Display
General
Identifying data
Jumper detection:
Interpret jumper F->G as a Type K thermocou
Here you can select the manner in which the jumper protection for a sensor is interpreted upon read-in of its data.
The setting only takes effect once configuration of the module has been carried out!
Reading/writing of Sensor-Eproms
Allow Eprom reading and writing ("Sensors" index card)
If the option is activated, transfer of Eprom-contents to XML-files or to the application "imc-Sensors" is enabled. Writing the contents of an XML-file or data from "imc-Sensor" to the Eprom is also enabled.

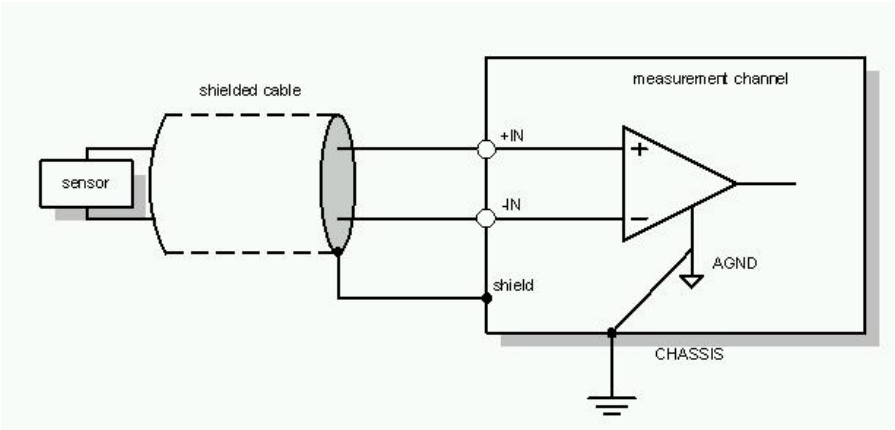
The following shows the existing possibilities and how UNI8 interprets them:

Signal source	Connection pins	The module recognizes
no measurement source	D-E open	ext. current source on, overload between +Sense and Sense
thermocouple Typ-K	F-G jumpered D-E open	ext. current source on, no voltage between +Sense and –Sense
RTD (Pt100) 3-line/ 4-line ¼ bridge resistance/ potentiometer Nippo Denso sensors with voltage adjustment	D-E jumpered RTD connected	sensible value for Pt100 (R<1000W)
unknown measurement source	D-E jumpered	Pt100 overloaded
measurement source with sensor recognition EPROM	Chip an D-E	

6.18.11 Connector plugs

For the pin assignment of the DSUB-15 plugs see here 445.

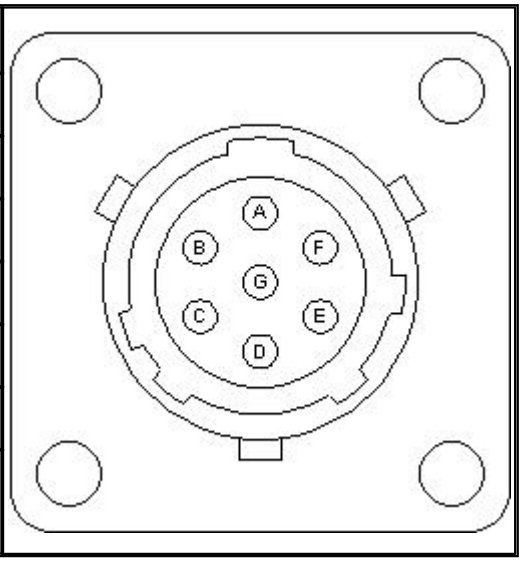
The measurement inputs should be connected using a shielded cable, in which the differential inputs A and B (+*IN* and -*IN*) are enclosed in the shielding



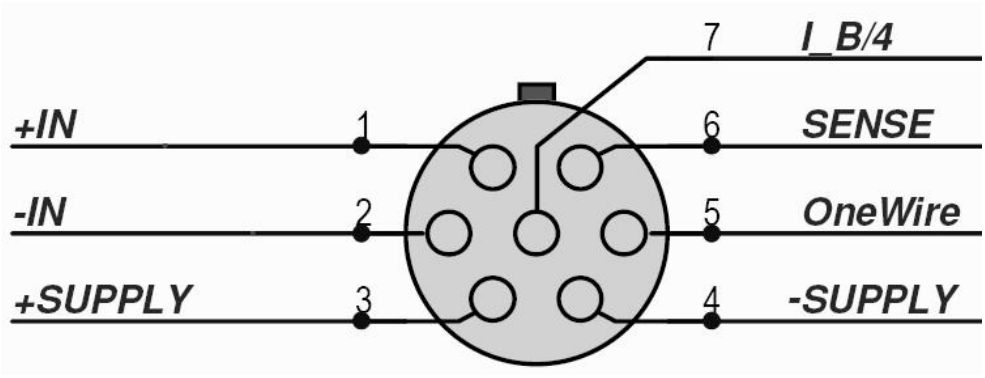
Important: The CANSAS-module must be grounded. Its frame is metal and conducting. The ground connection passes through a bolt on the back plane. Leaving aside safety considerations, grounding is usually necessary for measurement-technical reasons. Lack of grounding is often the problem in cases of noisy measurement values.

6.18.11.1 Pin configuration of round plugs ITT-VEAM (MIL-C-26482)

Signal	PIN/Circuit
pos. measurement input	A
neg. measurement input	B
positive sensor supply	C
negative sensor supply (device ground)	D
sensor recognition	E
sense-lead, RTD current source	F
quarter bridge completion, Sense-lead for RTD 3-wire connector	G



6.18.11.2 Pin configuration of round plugs LEMOSA

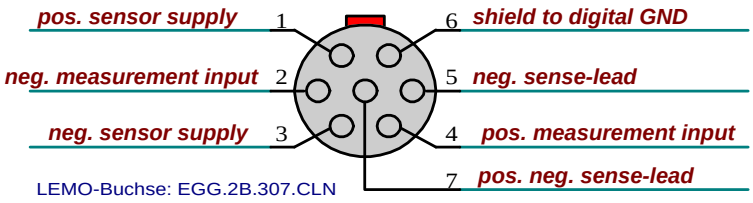


(view from outside to the device)

Signal	PIN	circuit
pos. measurement input	1	A
neg. measurement input	2	B
positive sensor supply	3	C
negative sensor supply (device ground)	4	D
sensor recognition	5	E
sense-lead, RTD current source	6	F
quarter bridge completion, Sense-lead for RTD 3-wire connector	7	G

This pin configuration applies also to CANSAS-SL-UNI8-L, see modules with LEMO plugs 455.

6.18.11.3 Pin configuration of round plugs ZF LEMO



(view from outside to the device.)

Signal	PIN	Circuit
positive sensor supply	1	C
neg. measurement input	2	B
negative sensor supply (GND)	3	D
pos. measurement input	4	A
negative sense-lead	5	F
shield to digital GND	6	D
positive sense-lead	7	---

Note!

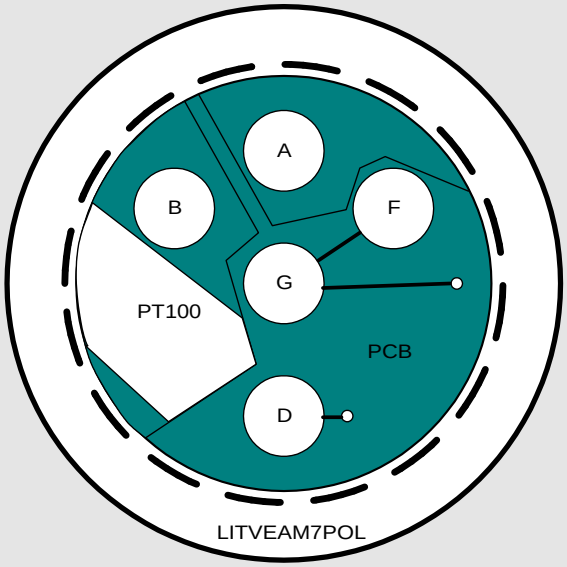
In this model, the contacts labeled G and E in the circuit diagram are omitted. Thus, the following functions are no longer available:

1. sensor recognition
2. ¼ bridge completion and measurement
3. thermocouples with Pt100 in connector
4. 3-wire Pt100 measurement
5. single ended current measurement
6. sensors with current signal

6.18.12 Assembly instructions for ITT VEAM with Pt100 inside of connector

For taking thermocouple measurements with Pt100 inside of the connector, you receive an junction plate onto which a Pt100 is soldered. The order in which the parts are assembled is crucial. Connection to the cable can take the form of either soldering or crimp connection.

7-pin LITVEAM-connector		Thermocouple	Pt100
designation	pin	designation	pin
+IN	A	Pos.	
-IN	B	Neg.	
+VB	C		
-VB	D		1
SenseID	E		
I-PT; Sense	F		2
SensePT	G		2

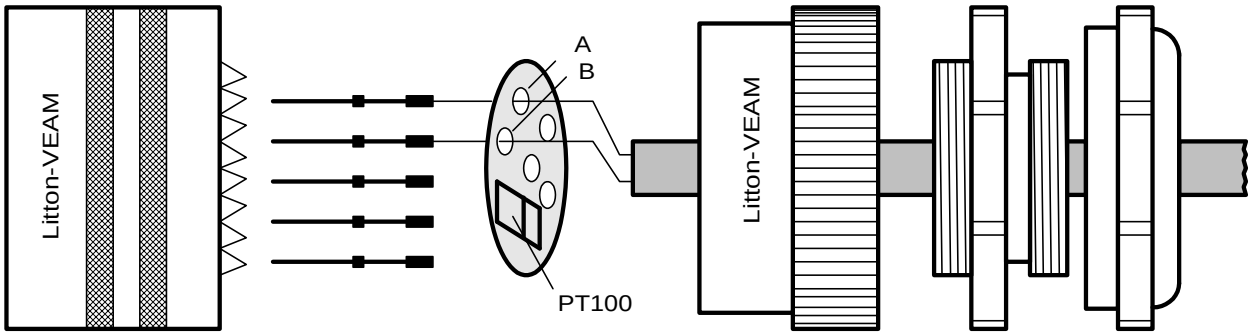


PT100 junction plate for ITT VEAM

Important!

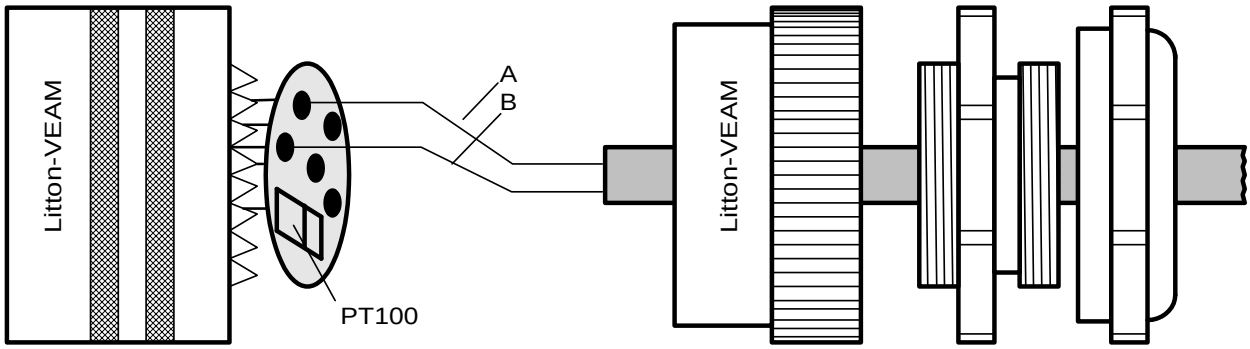
Be certain that the Pt100's contacts aren't shorted. 100 Ω must be measured between Pins G and D!

6.18.12.1 Connection using crimps



1. Thread the thermocouple's cable through the ITT VEAM connector's spacer and strain relief.
2. Pass the thermocouple's leads through the plate's holes.
3. Crimp the leads into the contacts.
4. Press the two crimped contacts and the other three contacts into the ITTVEAM connector.
5. Push the Pt100 plate onto the contacts.
6. Solder the contacts to the plate.

6.18.12.2 Connection by soldering



1. Press all the contacts into the ITT-VEAM connector.
2. Fit the Pt100 plate over the contacts and solder.
3. Thread the thermocouple's cable through the ITT VEAM connector's spacer and strain relief.
4. Solder the thermocouple's measurement leads.

IMPORTANT:

Make sure, that the connections of the PT100 are not bypassed. It should be possible to measure 100 Ω in between pin G and D.

6.18.12.3 Recommended tools

- VEAM contact inserter T98143
- For crimping:
  - Crimping pliers by DML M22520/1-01
  - Crimping adapter M22520/1-02

6.18.13 UNI8/DCB8-PROTECT

The UNI8 and DCB8 modules are also available in PROTECT model versions. These are equipped with DSUB-15 terminals and special protection from ESD (electrostatic discharge).

Suppressor diodes are used at the sensor supply which can limit the signal to 25 V even in response to high transients.

Furthermore, **discharge tubes** at the inputs +IN and SENSE protect against transient voltage surges (approx. 90 V trigger).

ESD filters with inductors and ferrite resistors are used at the terminals +-VB, +-Pt100, IN and SENSE.

Additionally, TEDS is supported.

☞ **These measures entail the following constraints:**

- The sensor supply is limited to a maximum of 15 V
- Shunt calibration of bridges is no longer accurate.
- Pt100 measurement in 3-wire mode is typically subject to an offset of 1.1 K

6.19 µ-CANSAS-V1

1-channel voltage measurement amplifier

Parameter	Value (typ. / max)	Remarks
Channels	1	1 channel on a 8-Pin Phoenix MPT0,5/8
Measurement mode	voltage measurement	connected depending on input range either via +IN_60 V with divider (2..60V) or via +IN_1 V without divider (0,1..1V) and -IN_COM

Technical data µ-CANSAS-V1. 422

µ-CANSAS-V1

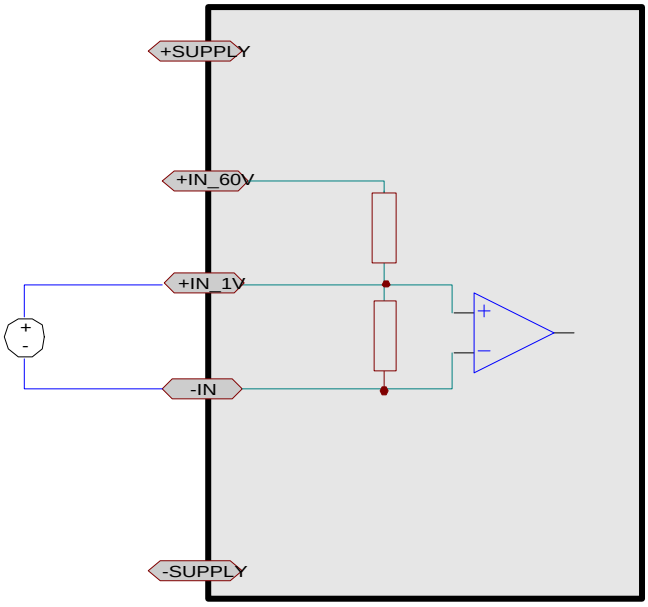
The single-channel module µ-CANSAS-V1 was designed to be used in very warm environments. It serves to capture voltages ranging from ±100 mV to ±60 V. The module provides a sensor supply voltage of 5 V or 10 V. Interference frequency components can be canceled by means of various filter types. The zero-taring capability enables the module to compensate for offsets.

☞ **Note**

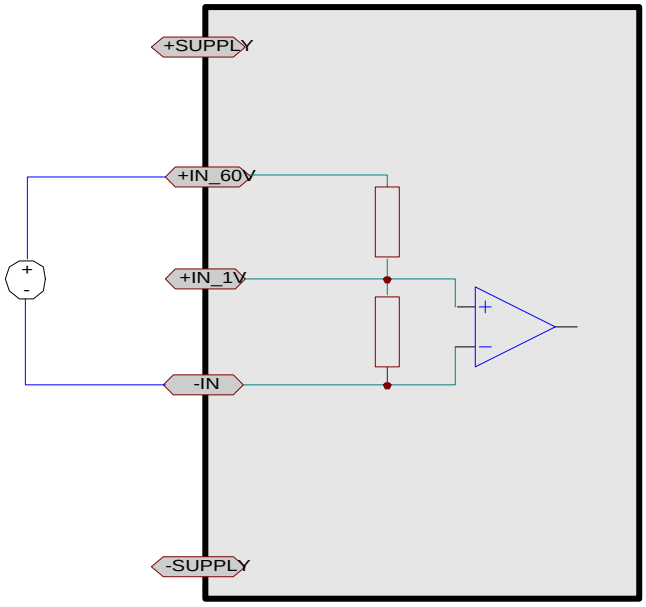
- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node *Special functions*.
- Beside working with CAN-bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section CANSAS blinking 188 codes.

6.19.1 Voltage measurement

- Voltage: ±60 V ... ±2 V connection via +IN_60 V and -IN_COM
- Voltage: ±1 V ... ±100 mV connection via +IN_1V and -IN_COM



Connection diagram for voltage up to ± 1V



Connection diagram for voltage > ± 1V

The differential input impedance for measurement of voltages from ±60 V to ±2 V is 900 kΩ; for measurement of voltages from ±1 V to ±100 mV it is 5 MΩ.

The input is DC-coupled. The differential behavior is achieved due to the insulated design.

Important note:

For voltage measurement in which zero-balancing (taring) is not permitted, the setting *No function* should be selected as the status display for *For "Not balanced"* in the LED dialog. Otherwise, the setting for the selected LEDs' behavior in *normal operation* mode is not displayed.

6.19.2 Voltage measurement: With zero-adjusting

In the measurement mode *Voltage: allow zero-balance* it is possible to perform balancing (taring) of the value measured.

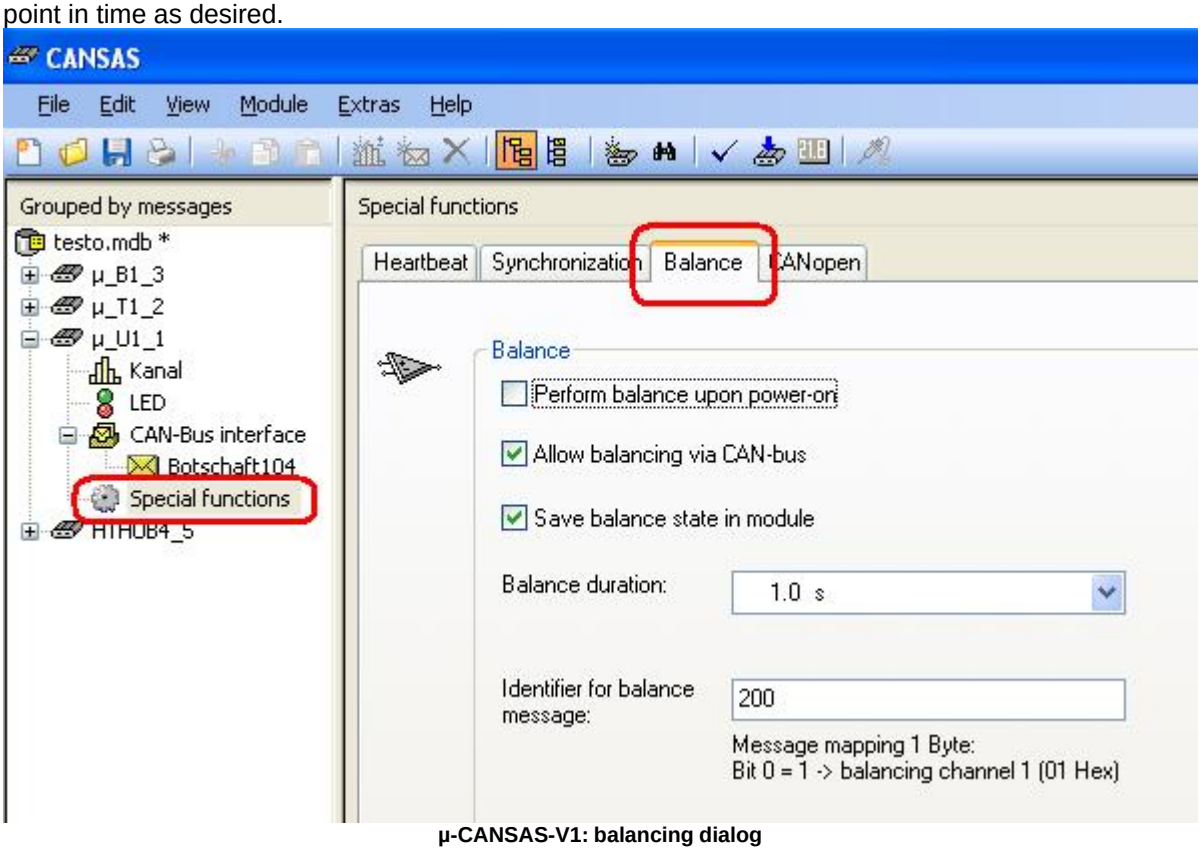
This is accomplished either by means of the channel menu command *Perform balancing for selections* in the Measurement window or on the page *Balance* under the module node *Special Functions*.

The initial offset may be many times the input range. If the initial offset is too large for compensation by the device, a larger input range must be set.

Input range [V]	Compensable initial offset* [V]		Input range [V]	Compensable initial offset* [V]
±50	20		±1	0,17
±20	15		±0,5	0,09
±10	7		±0,2	0,09
±5	12		±0,1	0,19
±2	15			

The maximum initial unbalance is the difference between the input range set and the possible input range. For instance, if the actual range for a setting of 50 V is 70 V and the one for the 20 V setting is 35 V, then the resulting possible initial unbalance is 20 V in the 50 V input range and 15 V in the 20 V input range.

The *Balance* dialog is located in the node *Special Functions*. It enables automatic balancing each time the device is activated. You can also store the balancing values in the module permanently, so that they are not lost as soon as the device is deactivated. It is also possible to perform a balancing procedure at a specific point in time as desired.



µ-CANSAS-V1: balancing dialog

Save balance state in module:
This optional setting ensures that the balancing values are not lost once the device is deactivated.

Balance duration:
Data acquisition for determining the averaged balancing value. If the input signal fluctuates somewhat around the rest state, a longer duration can cancel out these fluctuations.

Identifier:
A message to perform balancing must bear the identifier set here.

6.19.2.1 Balance upon power-up

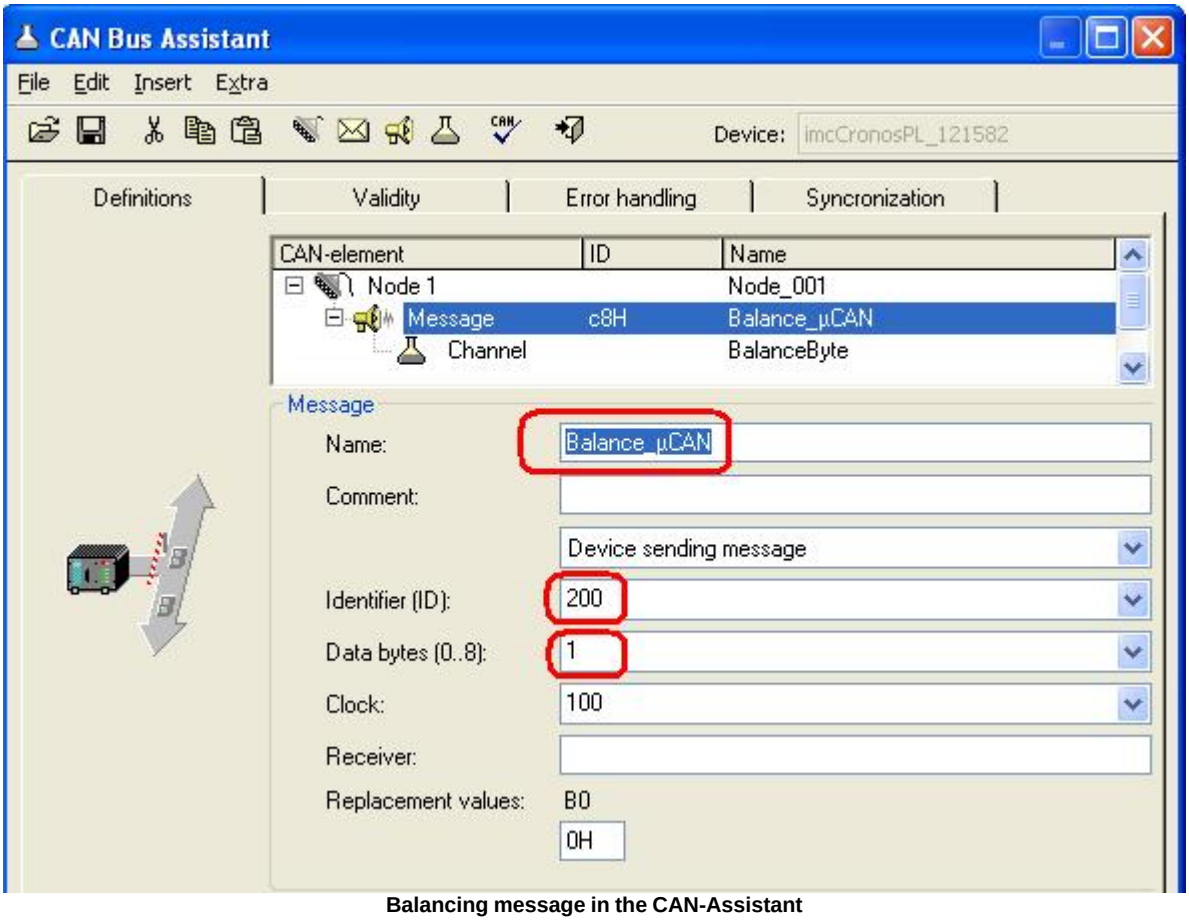
Each time it is activated, balancing of the module is carried out. However, this setting should only be used if it can be ensured that the sensors used are in rest state upon every activation. Otherwise there is a danger that a valid balancing will be written over due to a brief deactivation.

6.19.2.2 Activating balance via CAN-bus

This optional setting enables the module to be balanced at selected times. Towards this end, a CAN-message containing one data byte is sent to the module, whose value is 0x01Hex. It is helpful to combine this process with the next option *Save balance state in module*, since in that case the balancing value remains intact even after deactivation.

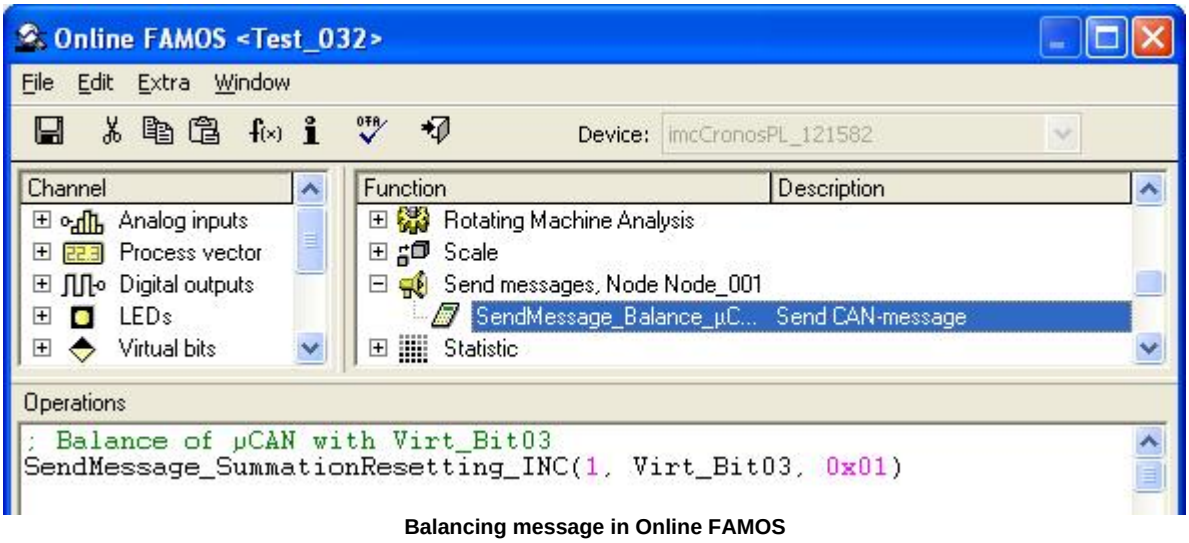
Example: Identifier for message to perform balancing = 200.

1. Creating the Send-message in the CAN-Assistant: A message with one data byte is required. Assign a distinct name to this message. Next assign this message to a channel. Since only one data byte is available, the length of this channel can have a maximum of 8 bits. All other settings do not play any role here.



Balancing message in the CAN-Assistant

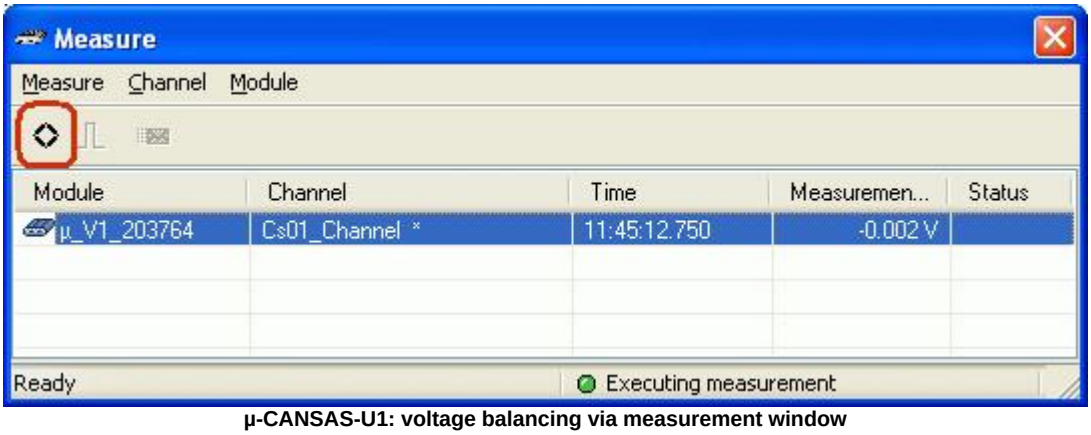
2. Online FAMOS sends a message if the virtual bit Bit03 is set. In the data byte, the value 01Hex is transmitted.



Balancing message in Online FAMOS

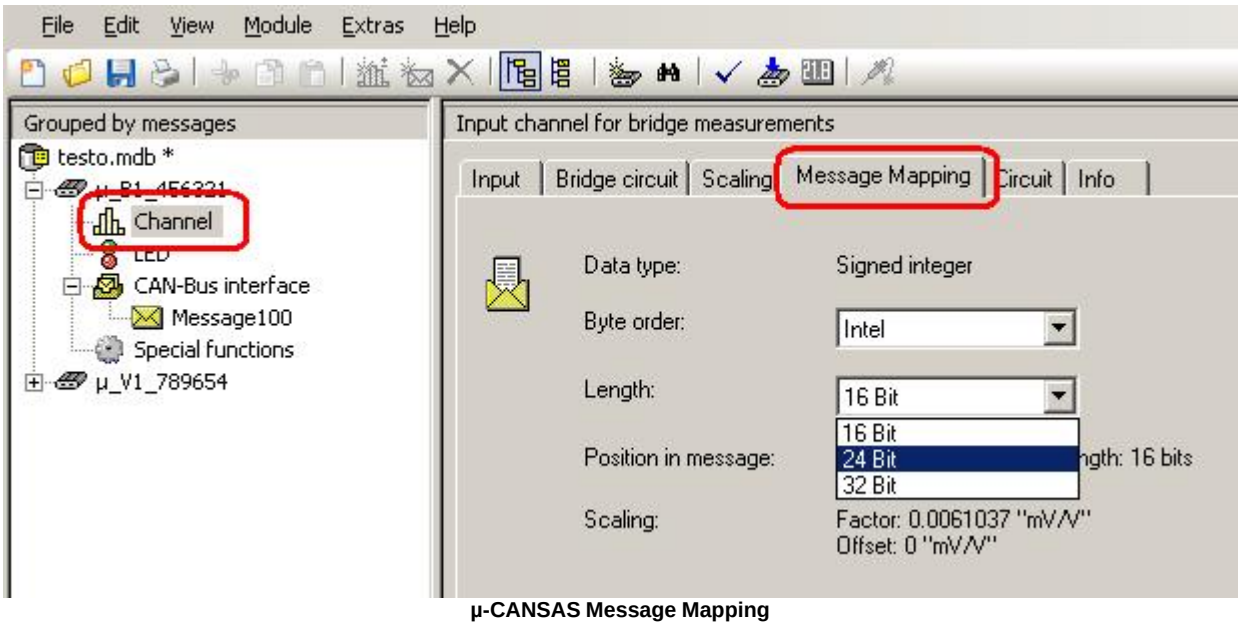
6.19.2.3 Voltage balancing via measurement window

In the measurement window, the balancing is performed by selecting the channel and touching the *Balance* button. Alternatively, the *Channel* menu offers the command *Perform balancing for selections*.



µ-CANSAS-U1: voltage balancing via measurement window

6.19.3 Message Mapping



µ-CANSAS Message Mapping

The modules belonging to the µ-CANSAS group work with a maximal resolution of 24 bits. The *Message Mapping* page also offers a message length of 32 bits, in which case a value in 32-bit Float format is transferred.

If four single-channel µ-CANSAS modules are connected via a µ-CANSAS-HUB4, note the following: if the values from four µ-CANSAS modules are to fit into one message, then a channel's length is limited to 16 bits. Since a message can transport a maximum of 8 data bytes, this amounts to only 2 bytes per channel. If 24 bits per channel are to be used, then with HUB at least two messages must be created for four channels

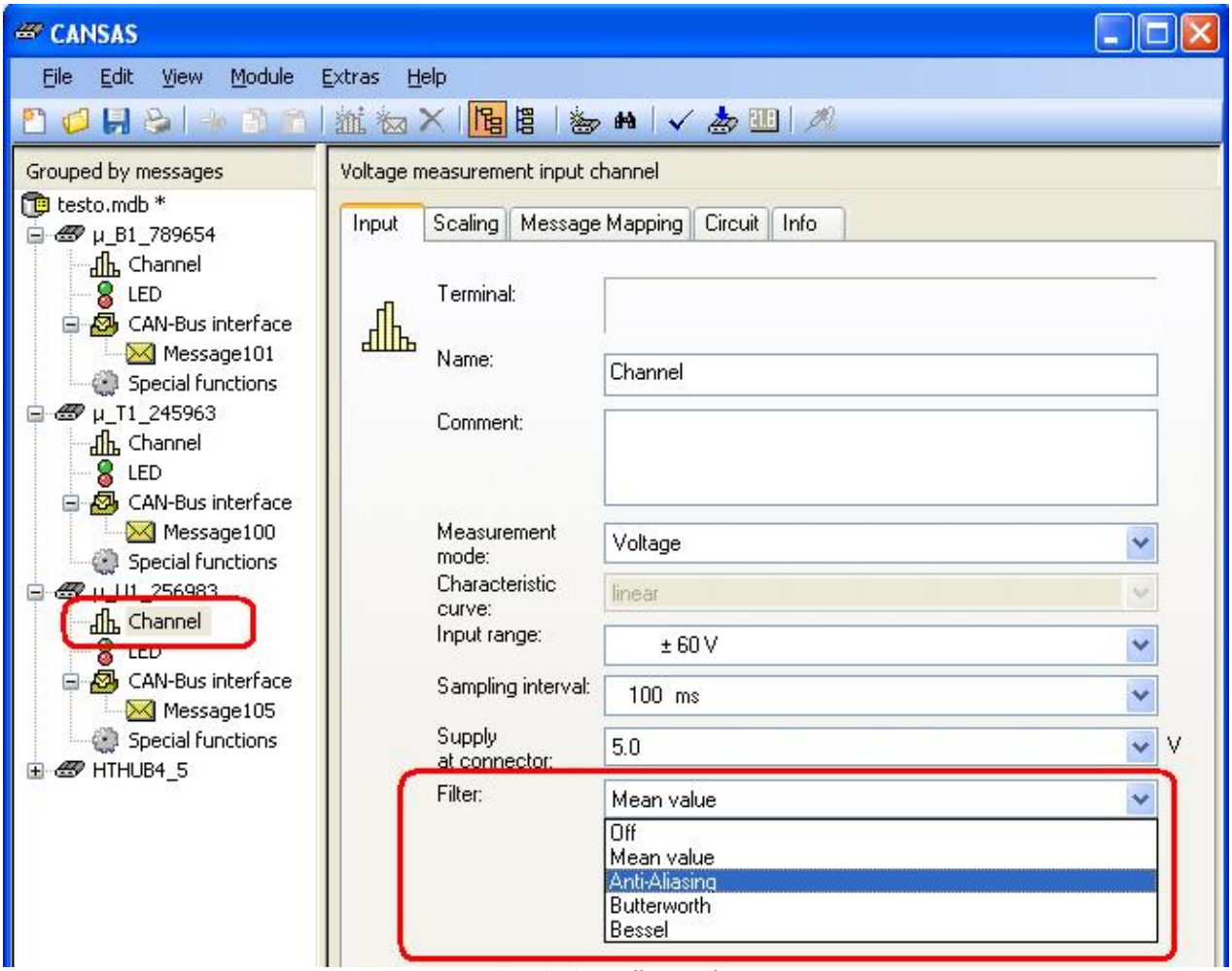
6.19.4 External Supply voltage +5 V/+10 V (isolated)

At the µ-CANSAS-V1's connection terminals, a supply voltage which is software-adjustable to either +5 V or +10 V is available for external sensors. This source is insulated and is connected via the contacts +SUPPLY and -SUPPLY.

Internally, this +5 V/+10 V supply output is electronically protected from short-circuiting and can carry a maximum load of 210 mW.

6.19.5 Sampling interval, filter

For µ-CANSAS-V1, sampling rates can be set in steps of 1, 2, and 5. The available sampling interval for the µ-CANSAS-V1 extends from 60s to 0,5 ms.



µ-CANSAS-V1 Filter settings

Off: Output of the last value sampled at the output clock rate set

Mean value: The output value is the mean value over (output clock rate [ms] / 500µs) values.

Anti-Aliasing-Filter: Low-pass filtering of the input signal with critical damping characteristics, 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at the 0,5 ms output clock rate)

Butterworth: Filtering of the input signal with Butterworth characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0,5 ms output rate). At output intervals >= 2s, an averaging filter is automatically used.

Bessel: Filtering of the input signal with Bessel characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0,5 ms output rate). At output intervals >= 2s, an averaging filter is automatically used.

Expert Settings:

When Expert Settings is activated, the order and cutoff frequency can be configured. The Expert Settings are only available for the filter types Butterworth and Bessel.

µ-CANSAS-V1: Expert Settings Filter

Filter	Order	lower cut off frequency	upper cut off frequency
Bessel	1	0,002 Hz	400 Hz
	2	0,008 Hz	400 Hz
	3	0,009 Hz	380 Hz
Butterworth	1	0,002 Hz	400 Hz
	2	0,02 Hz	400 Hz
	3	0,02 Hz	400 Hz

Note

- Please note the hint concerning double values with CANSAS modules and imcDevices/Studio 39.

6.19.6 µ-CANSAS-V1 connector

CAN-Bus connector see here 437. Cables see here 438.

Sensor connector with Phoenix see here 459. Sensor connector with Autosport AS plug see here 462.

6.20 µ-CANSAS-T1

1-channel temperature measurement amplifier

Parameter	Value (typ. / max)	Remarks
Channels	1	1 channel on 8-pin Phoenix MPT0.5/8
Measurement mode	Thermocouple measurement	R, S, B, J, T, E, K, N

Technical data µ-CANSAS-T1. 424

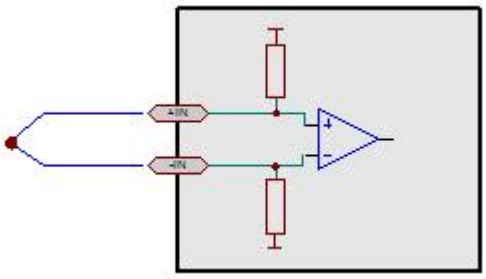
µ-CANSAS-T1

µ-CANSAS-T1 is a 1-channel differential measurement amplifier with 24-bit A/D-conversion for temperature measurements The conditioned and digitalized signal from analog sensors can be outputted as a CAN- or CANopen® signal. **µ-CANSAS-T1** is particularly designed for use in extremely warm environments.

☞ **Note**

- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node *Special functions*.
- Beside working with CAN-bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section CANSAS blinking 188 codes.

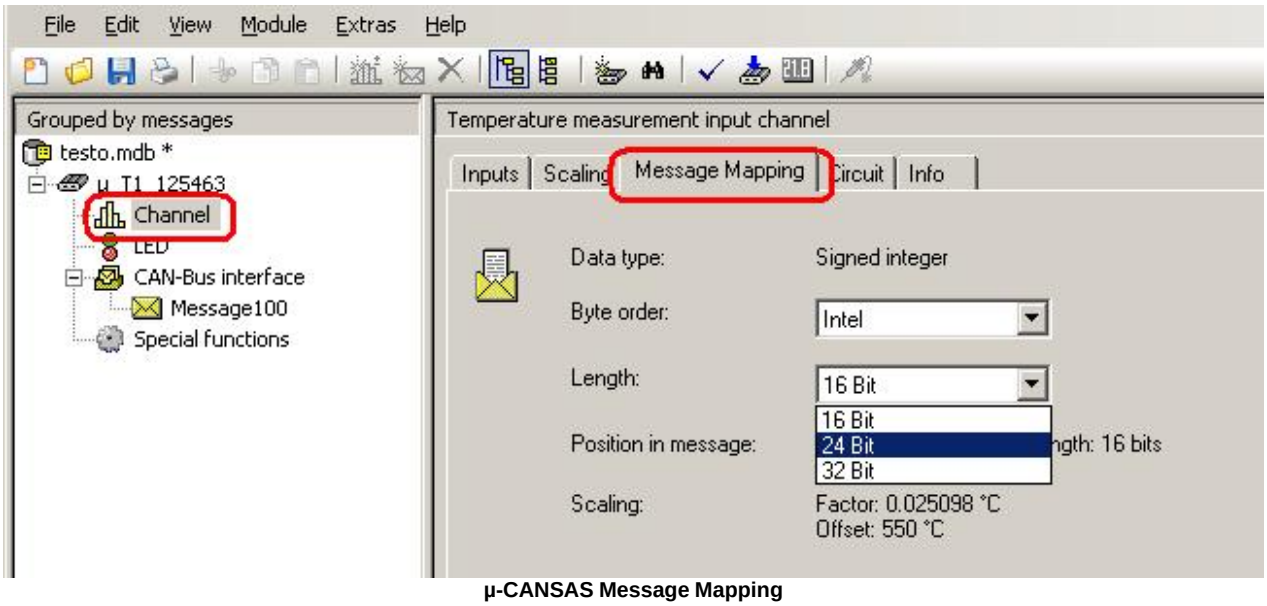
6.20.1 Temperature measurement



µ-CANSAS-T1: Connection diagram

The µ-CANSAS-T1 is designed for direct measurement of thermocouples; all commercially available thermocouple types 179, with their characteristic curves are supported. In contrast to the normal CANSAS modules the modules µ-CANSAS-T1 and µ-CANSAS-T4 are using the standard IEC584-1 / ITS90 to convert the voltage.

6.20.2 Message Mapping



µ-CANSAS Message Mapping

The modules belonging to the µ-CANSAS group work with a maximal resolution of 24 bits. The *Message Mapping* page also offers a message length of 32 bits, in which case a value in 32-bit Float format is transferred.

If four single-channel µ-CANSAS modules are connected via a µ-CANSAS-HUB4, note the following: if the values from four µ-CANSAS modules are to fit into one message, then a channel's length is limited to 16 bits. Since a message can transport a maximum of 8 data bytes, this amounts to only 2 bytes per channel. If 24 bits per channel are to be used, then with HUB at least two messages must be created for four channels.

6.20.3 Sampling interval, filter

For µ-CANSAS-T1, sampling rates can be set in steps of 1, 2, and 5. The available sampling interval for the µ-CANSAS-B1 extends from 60s to 0,5 ms.

With µ-CANSAS-T1, the following filter is set:

Mean value: The output value is the mean value over (output clock rate [ms] / 500µs) values. For temperature measurement, only averaging filtering is available.

6.20.4 µ-CANSAS-T1 connector

CAN-Bus connector see here 437. Cables see here 438.

Sensor connector with Phoenix see here 459. Sensor connector with Autosport AS plug see here 462.

6.21 µ-CANSAS-B1

1-channel bridge amplifier

Parameter	Value (typ. / max)	Remarks
Channels	1	1 channel on 8-Pin Phoenix MPT0,5/8
Measurement mode	DC-bridge measurement	no voltage measurement

Technical data µ-CANSAS-B1. 425

µ-CANSAS-B1

µ-CANSAS-B1 is a 1-channel differential measurement amplifier with 24-bit A/D-conversion for bridge measurements The conditioned and digitalized signal from analog sensors can be outputted as a CAN- or CANopen® signal. **µ-CANSAS-B1** is particularly designed for use in extremely warm environments.

The µ-CANSAS-B1's bridge channel has a DC voltage source (5V) to supply of the measurement bridge.

☞ **Note**

- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node *Special functions*.
- Beside working with CAN-bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section CANSAS blinking 188 codes.

6.21.1 DC-bridge measurement

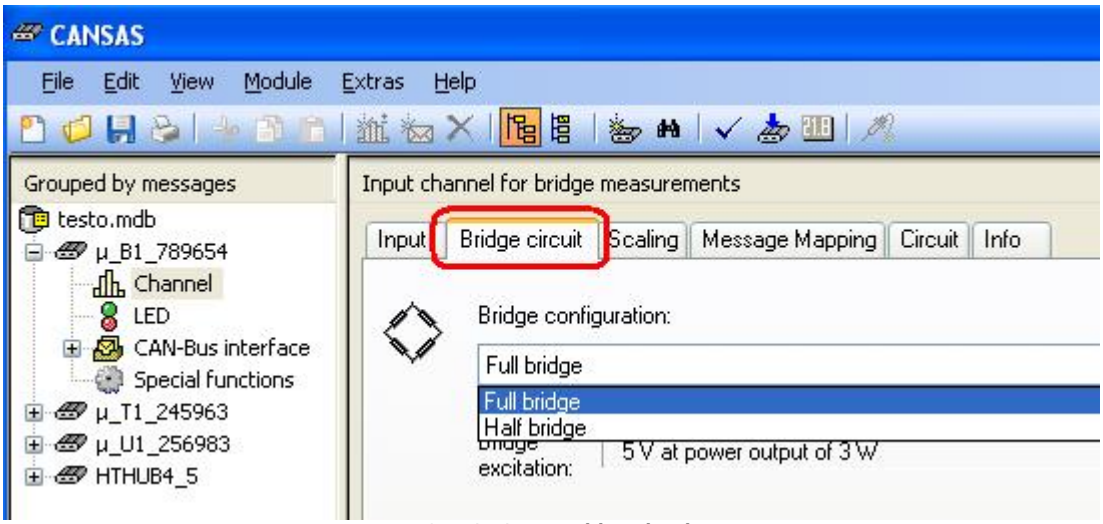
The current carrying capacity of the CANSAS module's voltage source allows the connection of **120Ω measurement bridges in all input ranges**.

The **Sense-terminal** provides compensation of voltage dissipation along long cables, which would otherwise cause noticeable measurement errors. If only plain cables are available, so that it is not possible to connect the Sense-line directly to the sensor, then **in all cases, +Sense** must be **connected with +VB** and **-Sense with** -**VB** at the terminal connector.

Bridge measurements are relative measurements (**ratiometric procedure**), in which there is an evaluation of what fraction of its supply input the bridge outputs (typically in the 0,1% range, corresponding to 1 mV/V). Calibration of the system is based on this ratio, the bridge input range. This means that the **actual magnitude of the bridge supply does not matter** and need not necessarily lie within the measurement's rated total accuracy.

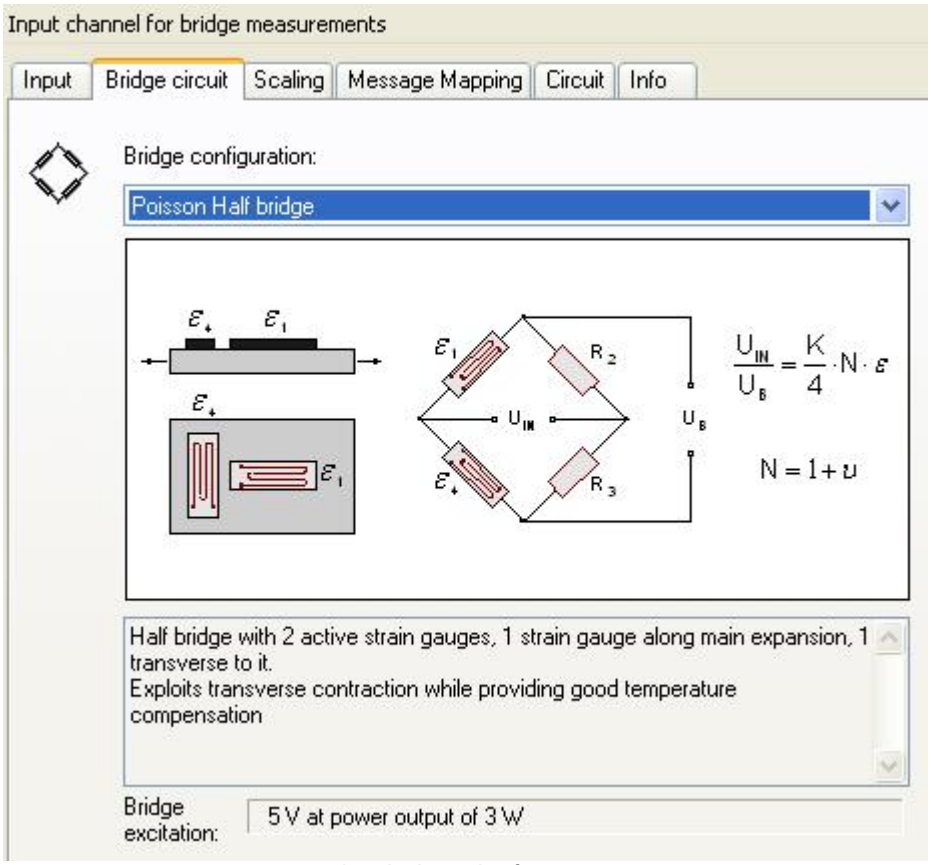
The following bridge types can be used as sensors with µ-CANSAS-B1:

- Full bridge
- Half bridge



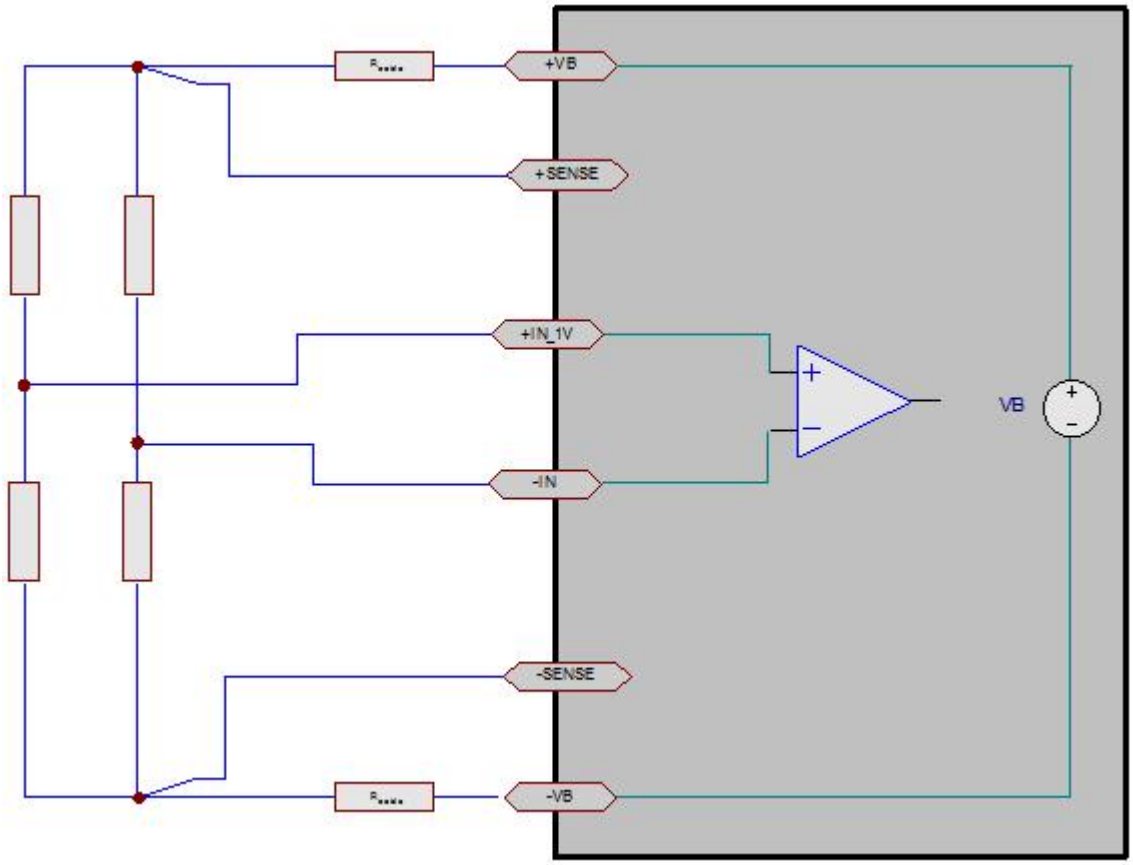
µ-CANSAS-B1: Bridge circuit

When using strain gauges, all common positioning arangements are available options for the module:


Input channel for bridge measurements
Input
Bridge circuit
Scaling
Message Mapping
Circuit
Info
Bridge configuration:
Poisson Half bridge
Half bridge with 2 active strain gauges, 1 strain gauge along main expansion, 1 transverse to it.
Exploits transverse contraction while providing good temperature compensation
Bridge excitation:
5 V at power output of 3 W

µ-CANSAS-B1: Strain gauges

6.21.2 Full bridge



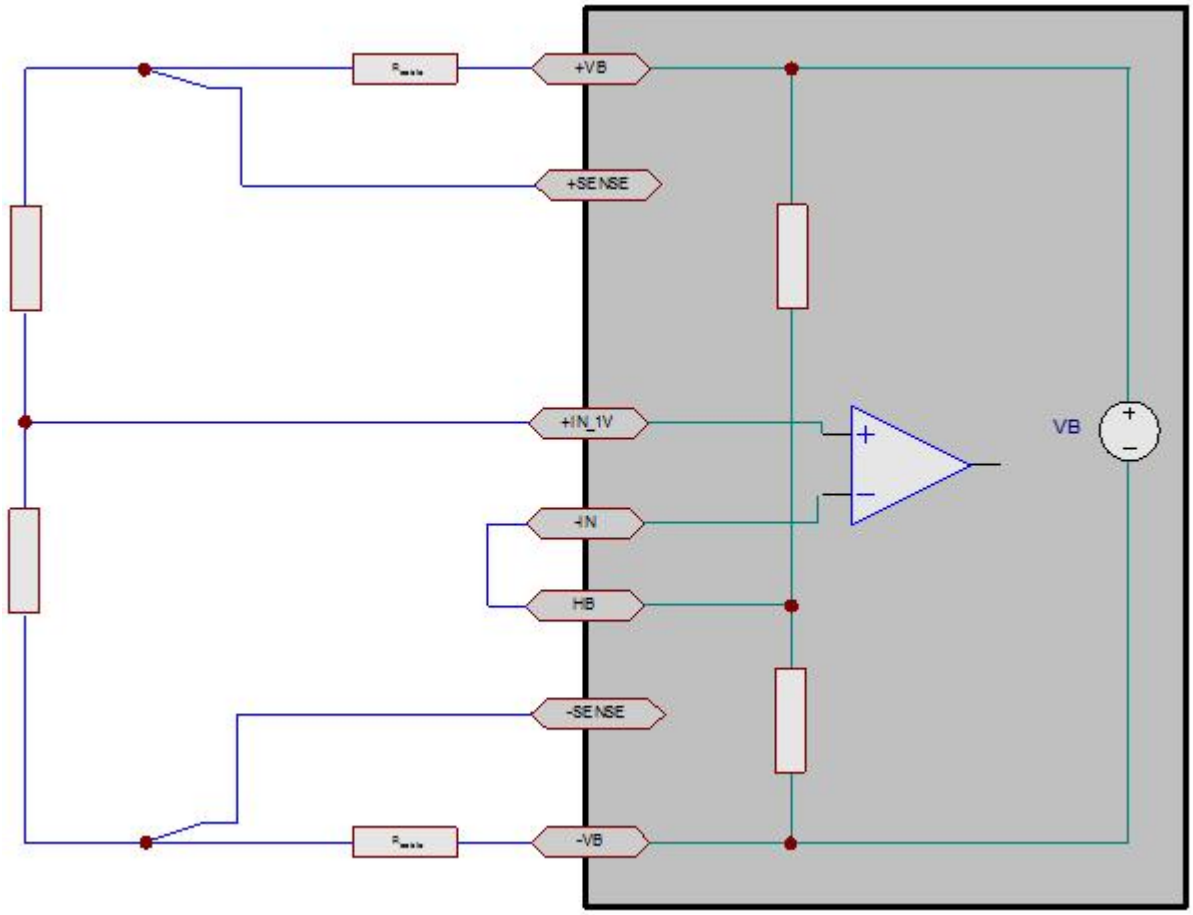
µ-CANSAS-B1: Full bridge

The full bridge consists of four resistor arms. All 4 of the bridge's resistors are outside of the CANSAS-module.

Input ranges:

- Voltage: ±200 mV/V ... ±0,5 mV/V connected at +IN_1V and -IN

6.21.3 Half bridge



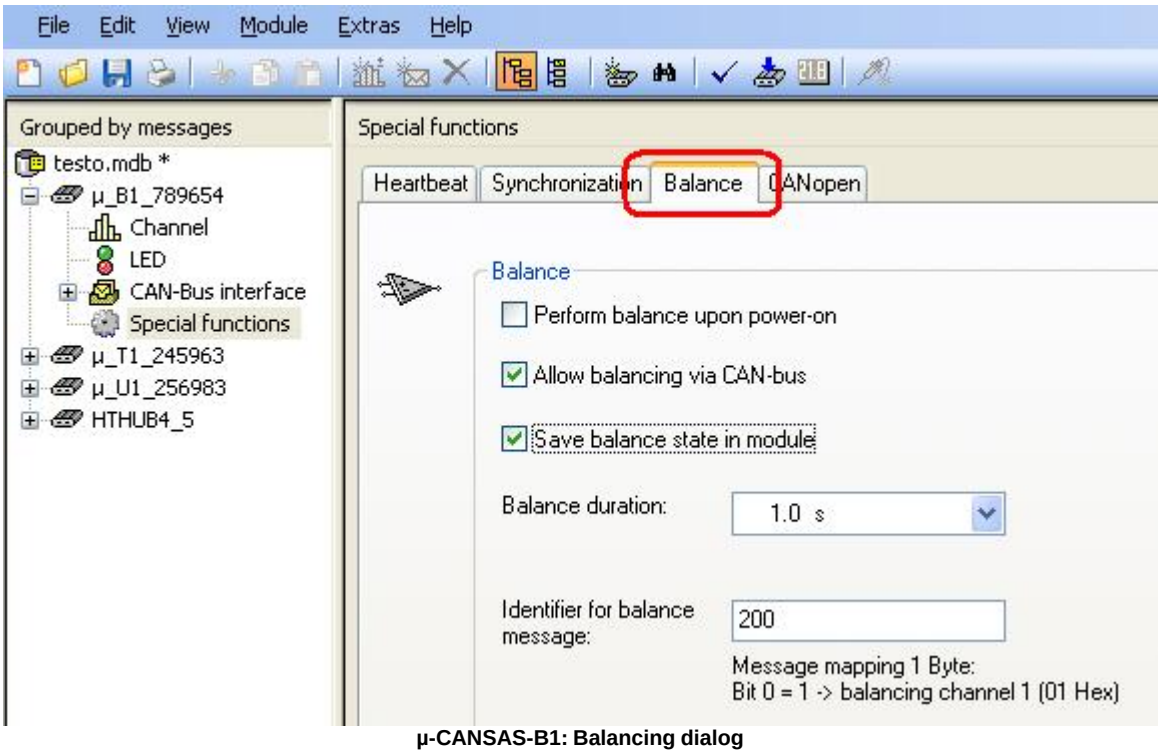
µ-CANSAS-B1: Half bridge

In many applications the sensor only comprises half of the full bridge, in other words two opposed variable resistors. The other half must be completed using a (highly constant) symmetric resistant conductors. With the µ-CANSAS bridge channel, this half-bridge completion is already available as a **pre-configured internal circuit**. It has an external contact “HB” at the terminal connector and only needs to be connected with the input pin -IN by means of a **wire jumper**.

Input ranges:

- Voltage: ±200 mV/V ... ±0,5 mV/V connected at +IN_1V and -IN

6.21.4 Bridge balancing



µ-CANSAS-B1: Balancing dialog

With µ-CANSAS-B1, there are a variety of ways to perform balancing:

- Bridge balancing upon power-up 370 automatically balances out the zero offset as soon as the module is activated.
- With Perform bridge balancing via the CAN-bus 370, a CAN-Bus message initiates the balancing process.
- The balancing procedure is performed in the measurement window.

Save balance state in module:
This optional setting ensures that the balancing values are not lost once the device is deactivated.

Balance duration:
Data acquisition for determining the averaged balancing value. If the input signal fluctuates somewhat around the rest state, a longer duration can cancel out these fluctuations.

Identifier:
A message to perform balancing must bear the identifier set here.

Any initial unbalance of the measurement bridge, for instance due to mechanical pre-stressing of the strain gauge in its rest state, must be zero-balanced. If the initial unbalance is too large to be compensated by the device, a larger input range must be set.

Input range [mV/V]	Bridge balancing*(VB = 5V) [mV/V]
±200	35
±100	18
±50	18
±20	38
±10	48
±5	54

*The bridge balancing is the difference between the input range set and the possible input range. For instance, if the actual range for a setting of 200 mV/V is 235 mV/V and the one for the 100 mV/V setting is 118 mV/V, then the resulting possible initial unbalance is 35 mV/V in the 200 mV/V input range and 18 mV/V in the 100 mV/V input range.

6.21.4.1 Bridge balancing upon power-up

Perform balance upon power-up:

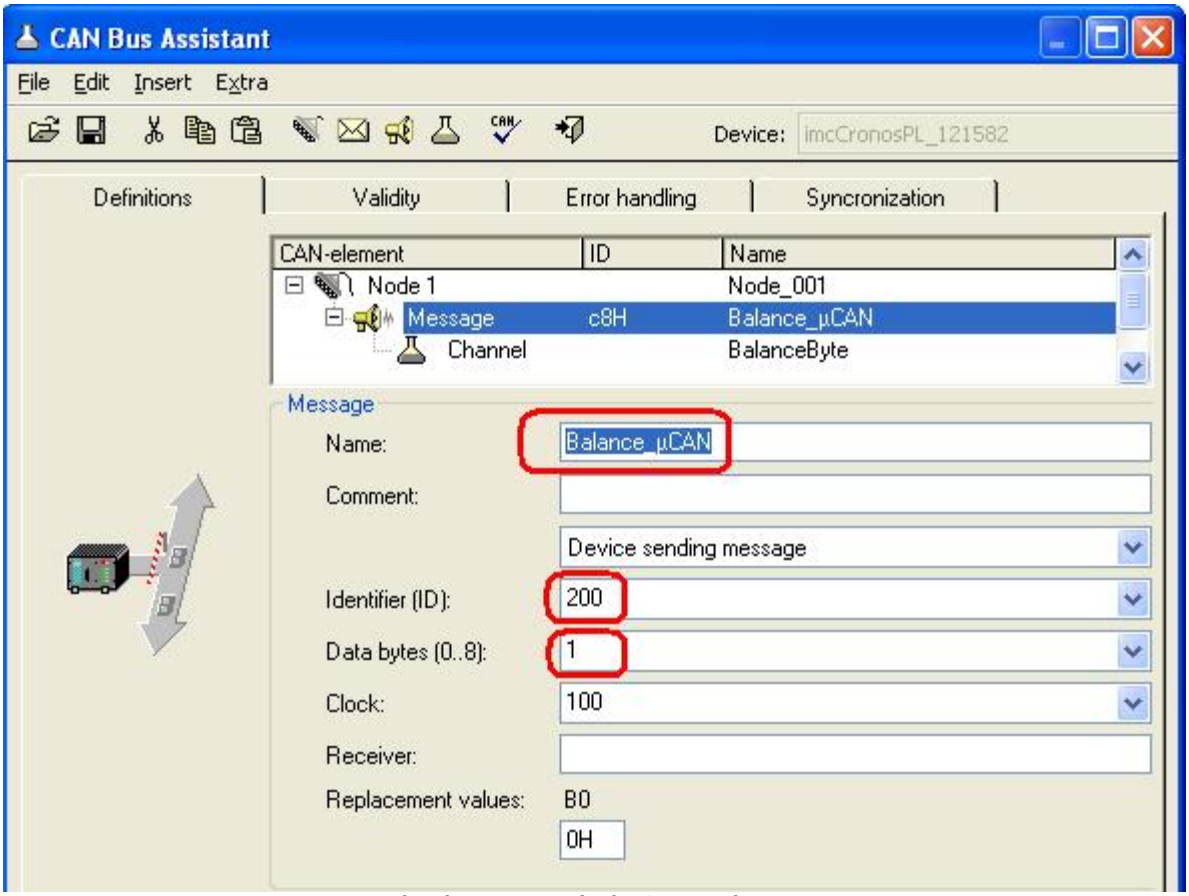
Each time it is activated, balancing of the module is carried out. However, this setting should only be used if it can be ensured that the sensors used are in rest state upon every activation. Otherwise there is a danger that a valid balancing will be written over due to a brief deactivation.

6.21.4.2 Perform bridge balancing via the CAN-bus

Allow balancing via CAN-bus:

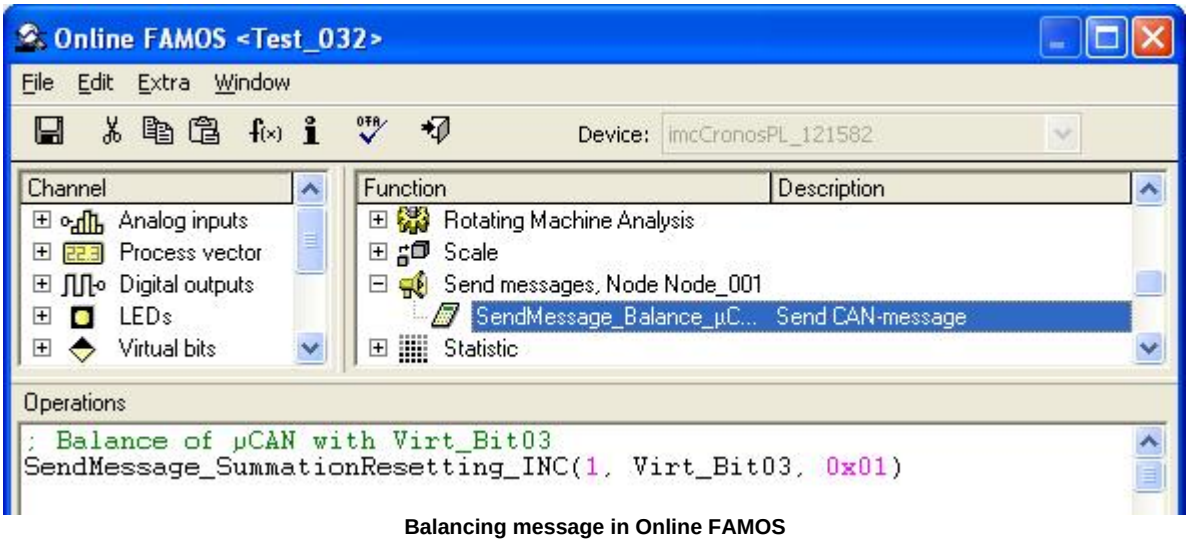
This optional setting enables the module to be balanced at selected times. Towards this end, a CAN-message containing one data byte is sent to the module, whose value is 0x01Hex. It is helpful to combine this process with the next option *Save balance state in module*, since in that case the balancing value remains intact even after deactivation.
Example: Identifier for message to perform balancing = 200.

1. Creating the Send-message in the CAN-Assistant: A message with one data byte is required. Assign a distinct name to this message. Next assign this message to a channel. Since only one data byte is available, the length of this channel can have a maximum of 8 bits. All other settings do not play any role here.



Balancing message in the CAN Assistenten

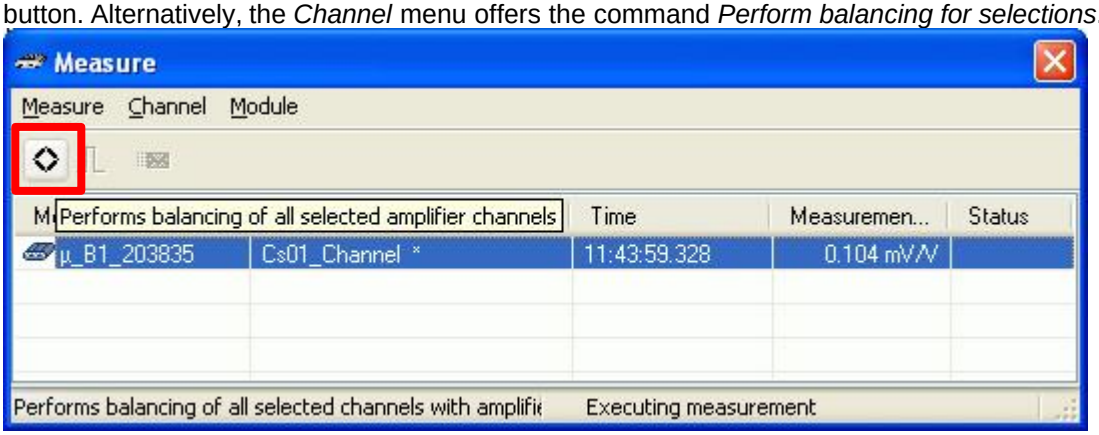
2. Online FAMOS sends a message if the virtual bit Bit03 is set. In the data byte, the value 01Hex is transmitted.



Balancing message in Online FAMOS

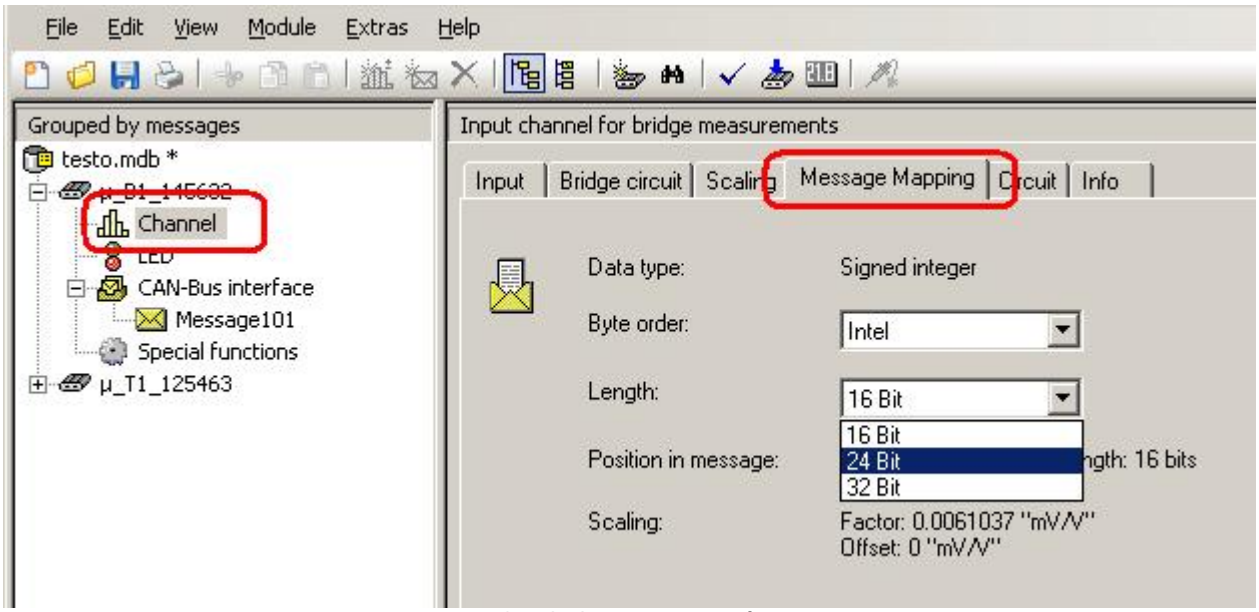
6.21.4.3 Balancing in the measurement window

In the measurement window, the balancing is performed by selecting the channel and touching the *Balance* button. Alternatively, the *Channel* menu offers the command *Perform balancing for selections*.



µ-CANSAS-B1: voltage balancing via measurement window

6.21.5 Message Mapping



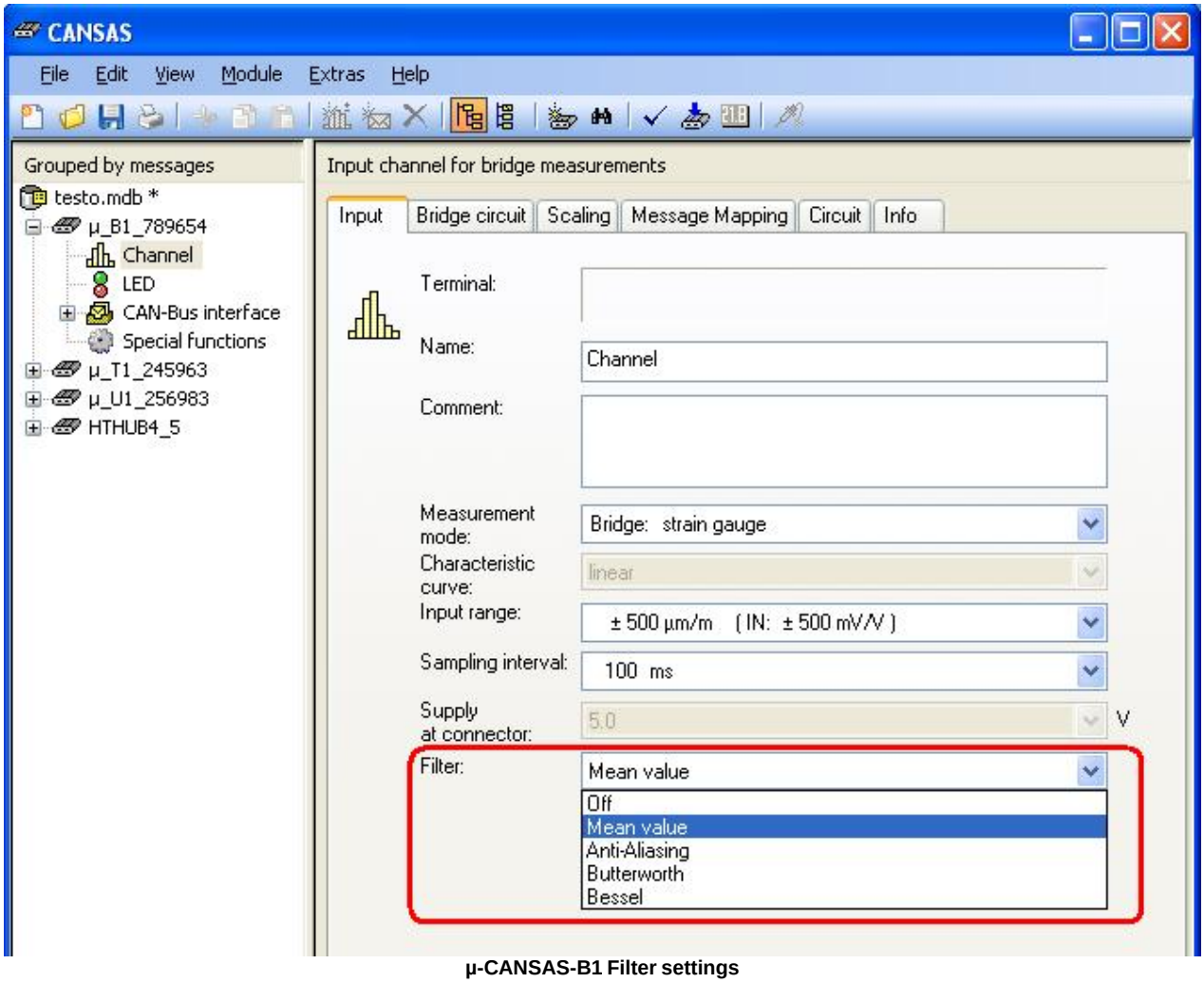
µ-CANSAS Message Mapping

The modules belonging to the µ-CANSAS group work with a maximal resolution of 24 bits. The *Message Mapping* page also offers a message length of 32 bits, in which case a value in 32-bit Float format is transferred.

If four single-channel µ-CANSAS modules are connected via a µ-CANSAS-HUB4, note the following: if the values from four µ-CANSAS modules are to fit into one message, then a channel's length is limited to 16 bits. Since a message can transport a maximum of 8 data bytes, this amounts to only 2 bytes per channel. If 24 bits per channel are to be used, then with HUB at least two messages must be created for four channels.

6.21.6 Sampling interval, filter

For µ-CANSAS-B1, sampling rates can be set in steps of 1, 2, and 5. The available sampling interval for the µ-CANSAS-B1 extends from 60s to 0,5 ms.



µ-CANSAS-B1 Filter settings

For µ-CANSAS-B1 the following filter settings are available:

Off: Output of the last value sampled at the output clock rate set

Mean value: The output value is the mean value over (output clock rate [ms] / 500µs) values. For temperature measurement, only averaging filtering is available.

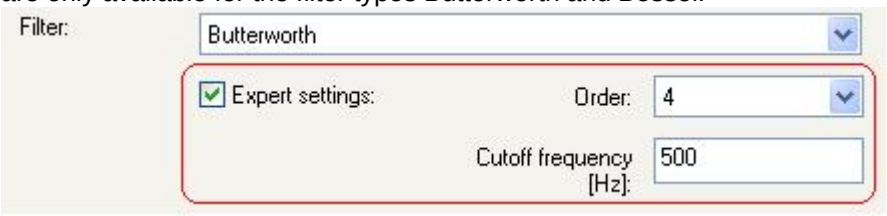
Anti-Aliasing-Filter: Low-pass filtering of the input signal with critical damping characteristics, 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at the 0,5 ms output clock rate)

Butterworth: Filtering of the input signal with Butterworth characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0,5 ms output rate). At output intervals >= 2s, an averaging filter is automatically used.

Bessel: Filtering of the input signal with Bessel characteristics
Default setting: 3rd order. Cutoff frequency = 1/6 of the output frequency (1/7 at 0,5 ms output rate). At output intervals >= 2s, an averaging filter is automatically used.

Expert Settings:

When Expert Settings is activated, the order and cutoff frequency can be configured. The Expert Settings are only available for the filter types Butterworth and Bessel.



µ-CANSAS-B1: Expert Settings Filter

Filter	Order	lower cut off frequency	upper cut off frequency
Bessel	1	0,002 Hz	400 Hz
	2	0,008 Hz	400 Hz
	3	0,009 Hz	380 Hz
Butterworth	1	0,002 Hz	400 Hz
	2	0,02 Hz	400 Hz
	3	0,02 Hz	400 Hz

Note

- Please note the hint concerning double values with CANSAS modules and imcDevices/Studio 39.

6.21.7 µ-CANSAS-B1 connector

CAN-Bus connector see here 437. Cables see here 438.

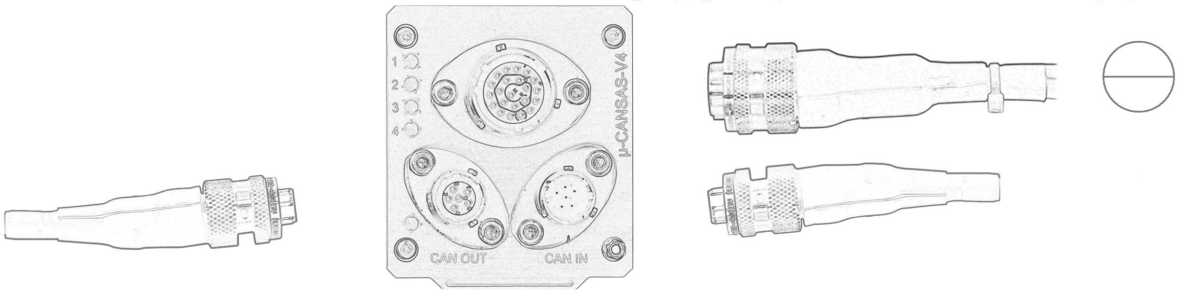
Sensor connector with Phoenix see here 459. Sensor connector with Autosport AS plug see here 462.

6.22 µ-CANSAS-V4

4-channel voltage measurement amplifier

Parameter	Wert (typ. / max)	Remarks
Channels	4	4 channels on one 22-Pin Autosport terminal (type AS212-35SN)
Measurement mode	Voltage measurement	2 connectors depending on voltage input range (+IN_60V and +IN_1V)

Signal plug AS for µ-CANSAS-V4-AS AS612-35PN 22 pol., 1160019



CAN-bus plug AS male AS608-35SA, 1160022

CAN-bus plug AS female AS608-35SA, 1160021

µ-CANSAS-V4

The µ-CANSAS-V4 comes with four integrated µ-CANSAS-V1 channels.

For the configuration of the channels, see the description of the µ-CANSAS-V1 355.

Technical data µ-CANSAS-V4. 422

Make note of the channels' **message mapping**. The channels can be sent together in one message in the customary manner or divided among multiple messages as desired. With each µ-CANSAS channel having a message length of 16 bits, all 4 channels can be sent by the HUB in one message. If a message length higher than 16 Bit (24 or 32 Bit) is set, then the 4 channels need to be distributed over 2 messages.

Note

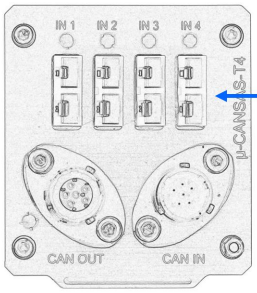
- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node *Special functions*.
- Beside working with CAN-bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section CANSAS blinking 188 codes.
- Please note the hint concerning double values with CANSAS modules and imcDevices/Studio 39.

CAN-Bus connector see here 437. Cables see here 438. **Sensor connector** see here 463.

6.23 µ-CANSAS-T4

4-channel temperature measurement amplifier

Parameter	Value (typ. / max)	Remarks
Channels	4	4 thermocouple connectors (with selectable type)
Measurement mode	Thermocouple measurement	R, S, B, J, T, E, K, N



Standard Omega 2-pin thermo plugs type K

CAN-bus plug AS male AS608-35SA, 1160022

CAN-bus plug AS female AS608-35SA, 1160021

µ-CANSAS-T4

The µ-CANSAS-T4 comes with four integrated µ-CANSAS-T1 channels.

For the configuration of the channels, see the description of the µ-CANSAS-T1 363.

Technical data µ-CANSAS-T4. 424

Make note of the channels' **message mapping**. The channels can be sent together in one message in the customary manner or divided among multiple messages as desired. With each µ-CANSAS channel having a message length of 16 bits, all 4 channels can be sent by the HUB in one message. If a message length higher than 16 Bit (24 or 32 Bit) is set, then the 4 channels need to be distributed over 2 messages.

☞ **Note**

- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node *Special functions*.
- Beside working with CAN-bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section CANSAS blinking 188 codes.

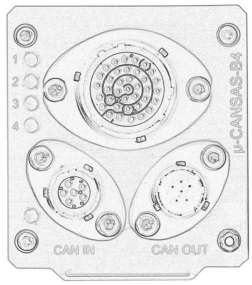
CAN-Bus connector see here 437. Cables see here 438.

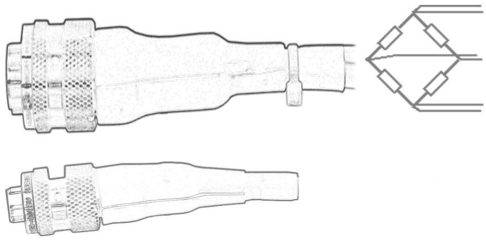
6.24 µ-CANSAS-B4

4-channel bridge amplifier

Parameter	Value (typ. / max)	Remarks
Channels	4	4 channels on one 37-Pin Autosport terminal (type AS214-35SN)
Measurement mode	DC-bridge measurement	no voltage measurement

Signal plug AS for µ-CANSAS-B4-AS AS614-35PN 37 pol., 1160018





CAN-bus plug AS male AS608-35SA, 1160022

CAN-bus plug AS female AS608-35SA, 1160021

µ-CANSAS-B4

The µ-CANSAS-B4 comes with four integrated µ-CANSAS-B1 channels.

For the configuration of the channels, see the description of the µ-CANSAS-B1 365.

Technical data µ-CANSAS-B4. 425

Make note of the channels' **message mapping**. The channels can be sent together in one message in the customary manner or divided among multiple messages as desired. With each µ-CANSAS channel having a message length of 16 bits, all 4 channels can be sent by the HUB in one message. If a message length higher than 16 Bit (24 or 32 Bit) is set, then the 4 channels need to be distributed over 2 messages.

☞ **Note**

- **Synchronization** is performed exclusively as Slave according to the CAN1-protocol and is provided under the node *Special functions*.
- Beside working with CAN-bus per default, the module is also configurable as **CANopen**® module.
- The functions of the LEDs are described in section CANSAS blinking 188 codes.
- Please note the hint concerning double values with CANSAS modules and imcDevices/Studio 39.

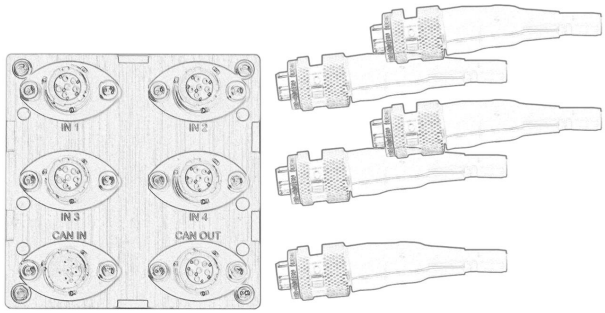
CAN-Bus connector see here 437. Cables see here 438. **Sensor connector** see here 463.

6.25 µ-CANSAS-HUB4

The µ-CANSAS-HUB4 serves to convert the CAN messages of up to 4 1-channel µ-CANSAS modules into one or more (max. 4) new CAN messages and to transmit them via the CAN-Bus.

The µ-CANSAS modules are **supplied** with power by the µ-CANSAS-HUB4 via the corresponding CAN-Bus pins.

4 x CAN-bus plug AS male AS608-35SA, 6 pol., 1160022
for CAN-in and power-out to connect up to four CAN/µ-xx1-AS(-T)



1 x CAN-bus plug AS female AS608-35SA, 1160022

1 x CAN-bus plug AS male AS608-35SA, 1160021

µ-CANSAS-HUB

A seperate CAN-Bus results from each connection between a 1-channel µ-CANSAS module and the µ-CANSAS-HUB4. The µ-CANSAS-HUB4 contains a built-in terminal resistor for each terminal at which a µ-CANSAS module can be connected.

Integration of the measurement modules into the system is accomplished in the same way as for the other modules. Depending on how many µ-CANSAS modules are connected to the µ-CANSAS-HUB4, the CANSAS user's interface displays the corresponding amount of channels for the respective µ-CANSAS-HUB4.

The channels can be sent together in one message in the customary manner or divided among multiple messages as desired. With each µ-CANSAS channel having a message length of 16 bits, all 4 channels can be sent by the HUB in one message. If a message length higher than 16 Bit (24 or 32 Bit) is set, then the 4 channels need to be distributed over 2 messages.

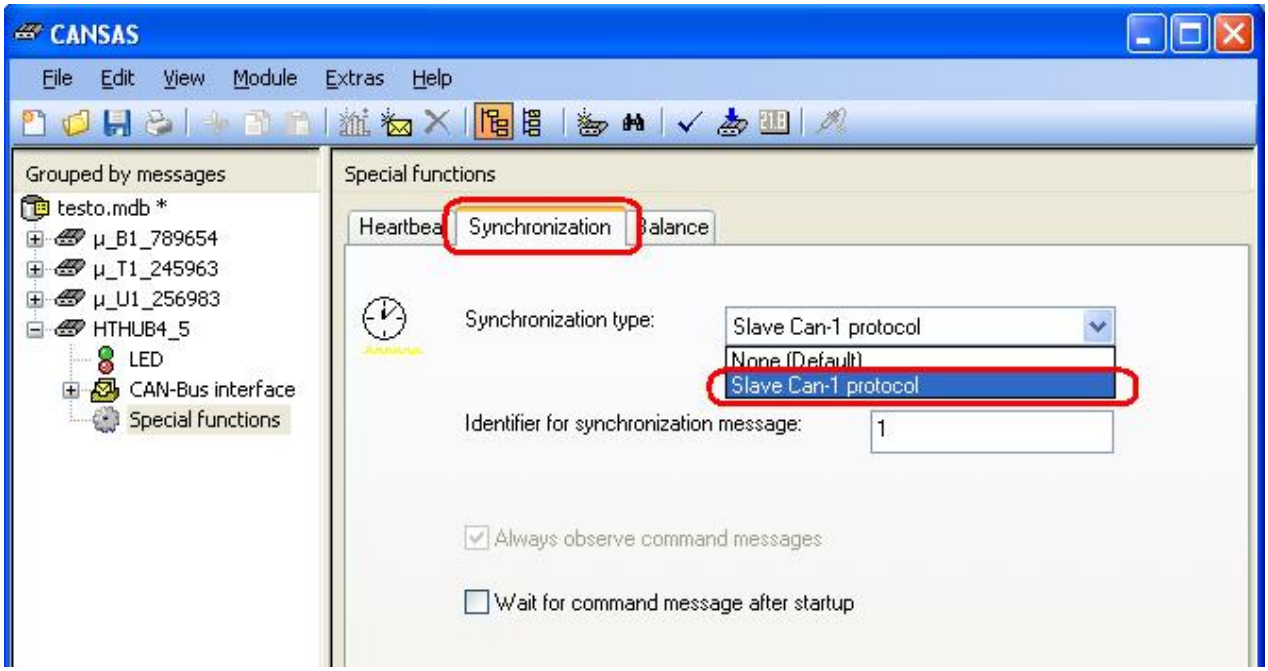
Technical data µ-CANSAS-HUB4. 426 CAN-Bus connector see here 437. Cables see here 438.
Sensor connector with Phoenix see here 459. Sensor connector with Autosport AS plug see here 462.

☞ **Note**

- The functions of the LEDs are described in section CANSAS blinking 188 codes.

6.25.1 Synchronization

Synchronization of the µ-CANSAS-HUB4 modules is performed exclusively as Slave according to the CAN1-protocol.



Within the HUBs, the µ-CANSAS modules connected are synchronized. If the µ-CANSAS-HUB4 is synchronized to CAN1-Slave, then the connected µ-CANSAS modules are also synchronized to the other synchronized CAN-Bus participants.

☞ **Note**

- For synchronization to be indicated by a blinking code, the LEDs must be configured accordingly. See the section CANSAS blinking codes 188.

General Technical Specs

General technical specs

- Built-in signal processor for online data compression, filtering, statistics and generation of virtual channels.
- Configurable by means of optional configuration software.
- Synchronized sampling of all measurement channels.
- Automatic activation upon application of supply voltage.
- 16-bit resolution.
- Number of virtual channels <100. Depending on the module, a certain number of virtual channels are already used internally. Those channels reduce the number of available virtual channels.
- Operating temperature -30°C to 85°C, condensation allowed. (unless otherwise indicated)
- Shock resistance 50g pk over 5 ms (without connector pods).
- Isolation strength to power supply and CAN-bus: ± 50 V (unless otherwise indicated)..
- TEDS base isolation
- Power supply 10 V to 50 V DC except from BRIDGE2, CANSER, C12 and ISO8: 9 V to 32 V DC. Modules build before April 2011: 9 V to 32 V, see specification label.
- power consumption 4W (unless otherwise indicated)

Unless otherwise indicated, the technical specs given are valid for the following ambient conditions:

- temperature 23°C
- air pressure 1013 mbar
- relative humidity 40%

General technical specs for SL modules

- Built-in signal processor for online data compression, filtering, statistics and generation of virtual channels.
- Configurable by means of optional configuration software.
- Synchronized sampling of all measurement channels.
- Automatic activation upon application of supply voltage.
- 16-bit resolution.
- Number of virtual channels <100. Depending on the module, a certain number of virtual channels are already used internally. Those channels reduce the number of available virtual channels.
- Operating temperature -30°C to -85°C, condensation allowed. (unless otherwise indicated)
- Shock resistance MIL STD810F (without connector pods).
- Isolation strength to power supply and CAN-bus: ± 50 V (unless otherwise indicated).
- Protection class IP65
- TEDS base isolation
- Power supply 10 V to 50 V, DC,
- power consumption 4W (unless otherwise indicated)

Unless otherwise indicated, the technical specs given are valid for the following ambient conditions:

- temperature 23°C
- air pressure 1013 mbar
- relative humidity 40%

µ-CANSAS modules and µ-CANSAS-HUB4 general technical data

- Integrated signal processor for online data compression, filtering, statistics and generation of virtual channels
- Configurable by means of optional configuration software
- Synchronized sampling of all measurement channels
- Automatic activation upon application of supply voltage
- 16-bit resolution
- Operating temperature -40°C to 120°C; Relative humidity: 95%; condensation allowed (unless otherwise indicated).
- Shock resistance: MIL STD810F (without terminal connector)
- Insulation from supply and CAN-Bus: ± 50 V (unless otherwise indicated)
- Power supply: 9 V to 50 V, DC,
- Power consumption: < 1W (unless otherwise indicated)

Unless otherwise indicated, the specifications apply under the following ambient conditions:

- temperature 23°C
- air pressure 1013 mbar
- relative humidity 40%

7.1 BRIDGE2

Datasheet Version 1.2 (2-channel bridge amplifier)

Parameter	Value (typ. / max)		Remarks
Inputs	2		1 channel each on DSUB-15 socket
Measurement mode	DC-bridge measurement		no voltage measurement
Sampling rate /channel	5 kHz (max.)		
Resolution	16 bit		
Input ranges	±10 mV/V, ±5 mV/V, ±2 mV/V, ±1 mV/V, ±0.5 mV/V, ±0.2 mV/V		
Bridge voltage	3.5 V_{DC}		3-wire circuit for compensation of cable resistance (+VB, +SENSE, -VB)
Bridge balancing range	±3 mV/V (min.)		in all input ranges
Bridge impedance	120 Ω (min.)		
Input configuration (configurable)	full bridge half bridge quarter bridge 120 Ω quarter bridge 350 Ω		default with wire bridge in the connector plug internal quarter bridge completion software selectable
Calibration resistor	100 kΩ		releasable via CAN-bus ; "Rcal" corresponds to: 0.30 mV/V at 120 Ω bridge or 0.87 mV/V at 350 Ω bridge
Cable length (max.)	28 m or max. 3 % of bridge impedance		for 120 Ω bridge with Cu-cable 0.14 mm^2, 130 mΩ/m: max. 3.6 Ω
Isolation: input/CAN-Bus input/power supply input / Analog	 ±60 V ±60 V no isolation		output to case (CHASSIS) nominal; testing voltage 300 V (10 s) nominal; testing voltage 300 V (10 s) analog reference ground: CHASSIS
Overvoltage protection	±20 V		short-term, to frame (CHASSIS)
Bandwidth	1 kHz (-3 dB)		
Noise	0.3 µV/V rms 2.0 µV/V pk_pk 0.2 µV/V pk_pk		bandwidth 10 Hz to 1 kHz bandwidth 10 Hz to 1 kHz low-frequency 0.1 Hz to 10 Hz
Input impedance	10 MΩ		
Gain uncertainty	<0.05 %		23°C
Gain drift	85 ppm/K	< 125 ppm/K	
Offset	<0.5 µV/V		after bridge balancing
Offset drift without ext. bridge	0.03 µV/V/K	0.3 µV/V/K	full bridge, bridge offset = zero
Offset drift with ext. bridge	1.0 µV/V/K	3.2 µV/V /K	half bridge, ext. bridge offset =3 mV/V
Bridge balancing release	1) via button on module 2) via CAN-Bus 3) during power-up		alternatively (configurable)
CAN-Bus	defined as per ISO 11898		
Supply voltage	9 V to 32 V DC		
Power consumption	4 W (typ.)		with 2x 120 Ω full bridge, 12 V supply
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D)	35 x 111 x 90 mm 41 x 128 x 145 mm		CANSAS-BRIDGE2 CANSAS-K-BRIDGE2
Weight	300 g / 900 g for K		
Terminal connections	2x DSUB-15 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)		inputs CAN (in / out) supply

Module description BRIDGE2 217

7.2 CANSER-GPS

Technical Specs Version 1.3 CANSER GPS

Parameter	Value (typ. / max)	Remarks
Supply voltage	9 V to 32 V DC	
Power consumption	<4 W	23°C
operating temperature	-30°C to 85°C	
Dimensions (W x H x D)	35 x 111 x 90 mm	
Connection terminals	2x DSUB-9 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	outputs CAN (in/out) supply

Encoding of reception signals:

Message	ID	Byte	Remarks
Time	2020	0-3	Long
Date	2020	4-7	Long
Longitude	2021	0-3	Real; negative for Western Hemisphere
Latitude	2021	4-7	Real; negative for Southern Hemisphere
Velocity	2022	0-3	Real; unit: knots
Direction (course over ground)	2022	4-7	Real; direction in °
Elevation (above sea level)	2023	0-3	Real; in m
Satellite count	2023	4-5	Integer; number of satellites used
Status	2023	6-7	1: valid; 0: maintenance

Module description CANSER-GPS 227

7.3 C12

Technical Specs Version 1.1 (12 analog inputs)

Parameter	Value (typ. / max)		Remarks
Inputs	12		6 channels on each DSUB-15 socket
Measurement modes	voltage voltage with divider current thermocouples Pt100		configurable in blocks of 6 standard-plug (CAN/DSUB-U6) divider-plug (CAN/DSUB-U6D) shunt-plug (CAN/DSUB-I6) thermo-plug (CAN/DSUB-T6) Pt100-plug (CAN/DSUB-PT): 4 channels with contacts for 4-wire connection or voltage plug (CAN/DSUB-U) 6 channels without contacts for 4-wire connection.
Terminal connections	2x DSUB-15 2x DSUB-9 PHOENIX (MC 1,5 / 4STF-3,81)		inputs CAN (in / out) supply
Sampling rate/channel	500 Hz (max.)		
Resolution	16 Bit		
Voltage input ranges:	±2 V, ±500 mV, ±100 mV ±50 V, ±10 V		with standard plug with divider plug
Current input ranges:	±40 mA, ±10 mA, ±2 mA		with shunt plug (50 Ω)
Thermocouple input ranges	-200°C to +1200°C		with thermo-plug , all common types
Pt100 input ranges	-250°C to +600°C		with Pt100-plug, I = 0,3 mA
Isolation: analog inputs CAN-bus power supply input	 no isolation ±60 V ±60 V		 to enclosure (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Channel isolation mutually:	 ±5 V ±40 V		max. difference between two input pins of any channels, (for C12 with divider: between [-]inputs) ensuring specified precision ensuring no damage
Overvoltage protection	±20 V ±40 V (high-Ohms during surge)		channel - chassis differential input voltage of a channel (long-term)
Common mode voltage	±2 V		channel-channel
Input configuration	DC, differential		isolated form: enclosure, supply and CAN-bus
Input impedance (static)	10 MΩ 500 kΩ 50 Ω		voltage, thermo voltage with divider current
Input current static dynamic	4 nA (typ.)	(max.) 40 nA 100 nA	after transients average dynamic input current
Gain uncertainty:	 <0.05 % <0.15 % <0.15 %		23°C with voltage plug with divider plug shunt plug
Gain drift	<75 ppm / K		
Offset	<0.02 %		throughout entire temperature range
Temperature uncertainty	<±1 K		sensor: type K at 20°C throughout entire temperature range
Noise	50 µV pp	7 µV rms	range ±100 mV, RSource = 50 Ω,

Parameter	Value (typ. / max)		Remarks
	25 mV pp	7 mV rms	sampling rate 2 ms range ±10 V (divider)
CMRR / IMR	>100 dB (50 Hz)		common-mode reference: enclosure (CHASSIS) all other channels: CHASSIS
Supply voltage	9 V to 32 V DC		
Power consumption	<2.5 W (typ.)	<3.0 W (max.)	12 V, throughout entire temperature range
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D)	35 x 111 x 90 mm 75 x 111 x 145 mm 40 x 128 x 145 mm		CANSAS-C12 CANSAS-L-C12-T CANSAS-K-C12 (8 TE Cassette)
Weight	300 g		

Module description C12 228

7.4 C8

Datasheet Version 1.4 (8 differential analog inputs, individually filtered and conditioned)

Parameter	Value (min./ max.)	Remarks
Inputs	8	
Measurement modes (DSUB):	voltage thermocouples, RTD current	 ACC/DSUB-I4
Measurement modes (LEMO):	voltage RTD current	with external shunt
Sampling frequency/ Channel	≤100 Hz	
Connection terminals	2x DSUB-15 / 4 channels or 8x BNC or 8x 2-pin TK sockets 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)	inputs only for voltage measurement only for Type K thermocouple measurement CAN (in / out), supply (alternatively) supply
Connection terminals for SL		
Inputs CAN (in / out)	2 plug DSUB-15/ 4channals 2x DSUB-9	CANSAS-SL-C8-D, (-SUPPLY) power supply (alternatively)
inputs CAN (in / out)	8x 7-pin LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310)	CANSAS-SL-C8-L, (-SUPPLY) power supply (alternatively)
DC power supply	1x 6-pin LEMO (HGA.1B.306)	for all SL models

Parameter	typ.	min. / max.	Remarks
Voltage measurement			
Input range	±60 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V, ±500 mV, ±200 mV, ±100 mV … ±5 mV		
Input impedance			differential
	1.00 MΩ	±1%	±60 V to ±2 V
	492 kΩ	>135 kΩ	±1 V to ±50 mV
	79 kΩ	>75 kΩ	±20 mV to ±5 mV
Gain uncertainty			of reading
	0.01 %	≤0.05 %	±60 V to ±200 mV
		≤0.02 %	±100 mV to ±20 mV
		≤0.05 %	±10 mV to ±5 mV
	5 ppm/K·ΔT_a	±20 ppm/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a
Offset uncertainty			of input range
	0.005 %	≤0.05 %	±60 V to ±200 mV
	0.005 %	≤0.01 %	±100 mV to ±20 mV
	0.02 %	≤0.06 %	±10 mV to ±5 mV
	±4 µV/K	<±12 µV/K	±60 V to ±2 V
	±0.07 µV/K	< ±0.16 µV/K	±1 V to ±5 mV
Common mode rejection Range			common mode test voltage
±60 V to ±2 V	70 dB	> 54 dB	±50 V
±1 V to ±5 mV	120 dB	>100 dB	±1 V
Isolation:			output to case (CHASSIS)
CAN-Bus	±60 V		nominal; testing voltage:300 V(10 s)
power supply input	±60 V		nominal; testing voltage:300 V(10 s)
analog input	no isolation		analog reference ground:CHASSIS
Overvoltage protection		±80 V	permanent channel to chassis

Parameter	typ.	min. / max.	Remarks	
Voltage measurement				
	±250 V		<1 ms	
Noise	51 nVrms 305 nVpkk		range ± 5 mV	bandwidth 100 Hz R_{source} = 50 Ω
Bandwidth	0 Hz to 20 Hz		-3 dB	

Parameter	typ.	min. / max.	Remarks
Temperature measurement			
Signal-noise ratio		>85 dB	bandwidth 10 Hz
Bandwidth	0 Hz to 10 Hz		-3 dB
Thermocouples			
Input ranges	J, T, K, E, N, S, R, B		per IEC 584
Resolution	 0.025 K 0.0031 K		type K -270°C to 1370°C -50°C to 150°C
Uncertainty thermocouples	±0.2K	<±0.5 K	Types J, T, K, E, L (for all other types, the voltage measurement uncertainty applies)
drift	±0.02 K/K·ΔT_a		ΔT_a= |T_a -25°C| ambient temperature T_a
Uncertainty of cold junction compensation		< ±0.15 K < ±0.5 K	CAN-C8-DSUB (standard) CAN-C8-K2
Drift of cold junction	±0.001 K/K·ΔT_j		ΔT_j = |T_j -25°C| ; could junction T_j
Input impedance	100 kΩ		differential
RTD (Pt100)			
Input range	-200°C to 850°C, -50°C to 150°C		≈0.016 K,≈0.003 K (resolution)
Uncertainty		<±0.2 K <±0.1 K <±0.05 %	-200°C to 850°C, four-wire connection -50°C to 150°C, four-wire connection plus of range
Drift		±0.01 K/K·ΔT_a	ΔT_a=|T_a -25°C| ambient temperature T_a
Pt100 sensor feed	625 µA		
Input impedance	20.0 MΩ	±1 %	differential

General		
Dimensions (W x H x D)	35 x 111 x 90 mm	CANSAS-C8
	75 x 111 x 145 mm	CANSAS-L-C8, -L-C8-SUPPLY
	41 x 128 x 145 mm	CANSAS-K-C8 (8 HP cassette)
	81 x 128 x 145 mm	CANSAS-K-C8-BNC, -K-C8-2T CANSAS-K-C8-SUPPLY
	58 x 112.5 x 152 mm	CANSAS-SL-C8-L
	38 x 112.5 x 152 mm	CANSAS-SL-C8-D
	78 x 112.5 x 152 mm	CANSAS-SL-C8-L-SUPPLY
	58 x 112.5 x 152 mm	CANSAS-SL-C8-D-SUPPLY
Supply voltage	10 V to 50 V DC	
Sensor supply	2.5 V to 24 V	technical specs sensor supply 427
Operating temperature	-30°C to 85°C	

Module description C8 231

7.5 CI8

Datasheet Version 1.6 (8 differential analog inputs, individually filtered and conditioned)

Parameter	typ.	min. / max.	Remarks
Inputs	8		2x DSUB-15 / 4 channels
Measurement modes (DSUB)	voltage thermocouples, RTD (Pt100) current resistor		ACC/DSUB-U4 ACC/DSUB-T4 ACC/DSUB-I4 (shunt connector) ACC/DSUB-T4
Measurement modes (LEMO and ITT Veam)	voltage RTD (Pt100) Current resistor		
Measurement mode (2T)	thermocouples type-K		
Sampling frequency/channel	≤1 kHz		
Bandwidth	440 Hz		- 3 dB without lowpass filter
Filter cutoff frequency filter characteristic	1/6 of sampling rate		digital lowpass, Butterworth, Bessel 2. order
Connection terminals	2 plug DSUB-15, 4 channels per plug or 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)		CANSAS-L-CI8 CAN (in / out), supply (alternative) power supply
	ITT-Veam (VPT02Y10-7S)		CANSAS-L-CI8-V-SUPPLY CANSAS-L-CI8-V
Connection terminals for SL inputs: CAN (in / out): inputs: CAN (in / out) DC power supply:	2 plug DSUB-15, 4 channels per plug 2x DSUB-9 8x 7 pin LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)		 CANSAS-SL-CI8-D, (-SUPPLY) ACC/DSUB-(X4)-IP65 power supply (alternatively) CANSAS-SL-CI8-L, (SUPPLY) power supply (alternatively) for all SL models

Voltage and current measurement				
Parameter	**typ.**	**min. / max.**	**Remarks**	
Voltage input ranges	±20 mV, ±50 mV, ±100 mV, ±200 mV, ±500 mV, ±1 V, ±2 V, ±5 V, ±10 V, ±20 V, ±60 V			
Current input ranges	±10 mA, ±20 mA		with shunt-plug (Shunt 50 Ω) (ACC/DSUB-I4)	
Gain uncertainty	<0.025 % <0.07 %	<0.05 % <0.15 %	voltage, 23°C current with shunt-plug	
Offset uncertainty	15 µV or 4LSB		range ≤100 mV range >100 mV	
Non-linearity	<40 ppm	<60 ppm	range ±10 V	
Gain drift		6 ppm/K 50 ppm/K	ranges ≤±2 V ranges ≥±5 V	over full temperature range
Offset drift		2.5 ppm/K	over full temperature range	
Input voltage noise	7.2 µVrms 36 µVpkk		range ±20 mV	sampling rate 1 kHz, R_{source} = 0 Ω
IMR (isolation mode	>145 dB (50 Hz)		range ≤±2 V	R_{source} = 0 Ω

Voltage and current measurement				
Parameter	**typ.**	**min. / max.**	**Remarks**	
rejection)	>70 dB (50 Hz)		range ≥±5 V	
Channel isolation	>1 GΩ, < 40 pF >1 GΩ, < 10 pF		channel-to-ground (protection ground) channel-to-channel	
Channel isolation (crosstalk) channel-to-channel	>165 dB (50 Hz) >92 dB (50 Hz)		range ≤±2 V range ≥±5 V	R_{source} ≤100 Ω

Temperature measurement - thermocouples			
Parameter	**typ.**	**min. / max.**	**Remarks**
Measurement range	R, S, B, J, T, E, K, L, N		according IEC 584
Resolution	0.063 K (1/16K)		
Measurement uncertainty		<±1.0 K	type K
Temperature drift	±0.02 K/K·ΔT_a		ΔT_a= $\lvert T_a$ -25°C$\rvert$ ambient temperature T_a
Uncertainty of cold junction compensation temperature drift	 ±0.001 K/K·ΔT_j	<±0.15 K	ACC/DSUB-T4 ΔT_j = $\lvert T_j$ -25°C$\rvert$ cold junction temperature T_j
Temperature measurement – Pt100			
Measurement range	-200°C to +850°C -50°C to +150°C		
Resolution	0.063 K (1/16K)		
Measurement uncertainty	< ±0.2 K < ±0.05 %		–200°C to +850°C, 4-wire connection plus of reading
Temperature drift	±0.01 K/K· ΔT_a		ΔT_a=$\lvert T_a$ -25°C$\rvert$; ambient temp. T_a
Sensor feed (PT100)	250 µA		
Resistance measurement			
Measurement range	0 Ω to 150 Ω, 250 Ω 0 Ω to 500 Ω, 1 kΩ		

General			
Parameter	**typ.**	**min. / max.**	**Remarks**
Isolation: CAN-Bus power supply input analog input	 ±60 V ±60 V ±60 V		channel to case (chassis) and channel-to-channel nominal; testing voltage: 300 V (10 s) nominal; testing voltage: 300 V (10 s) nominal; testing voltage: 300 V (10 s)
Overvoltage protection	±60 V ESD 2 kV transient protection: automotive load dump ISO 7637, Testimpuls 6		differential input voltage (continuous) human body model test pulse 6 with max. –250 V Ri=30 Ω, td=300 µs, tr<60 µs
Input coupling configuration	DC, isolated (differential)		isolated to System-GND (case, CHASSIS)
Input impedance	10 MΩ 1 MΩ 50 Ω		voltage mode (range ≤±2 V), temperature mode voltage mode (range ≥±5 V) current mode (shunt-plug)

General			
Parameter	**typ.**	**min. / max.**	**Remarks**
Input current operating conditions on overvoltage condition		 1 nA 1 mA	 |Vin| >5 V on ranges <±5 V or device powered-down
TEDS - Transducer Electronic DataSheets	conformant to IEEE 1451.4 Class II MMI		
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 TPDOs in INT16, INT32, and FLOAT		
Power supply	10 V to 50 V DC		
Power-consumption of analog conditioning	< 4.5 W		24 V_{DC}
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D)	55 x 111 x 145 mm 40 x 128 x 145 mm 58 x 112.5 x 152 mm 38 x 112.5 x 152 mm 78 x 112.5 x 152 mm 58 x 112.5 x 152 mm		CANSAS-L-CI8(-SUPPLY), 2T, CANSAS-L-CI8-V(-SUPPLY) CANSAS-K-CI8, -BNC CANSAS-SL-CI8-L CANSAS-SL-CI8-D CANSAS-SL-CI8-L-SUPPLY CANSAS-SL-CI8-D-SUPPLY
Weight	560 g		

Optional: sensor supply			
Parameter	**typ.**	**min./max.**	**Remarks**
Ranges	7		selectable, global to all channels
Standard version	+2.5 V to +24 V		non-isolated
Upon request	isolated versions +2.5 V to ±15 V, +24 V		 non-isolated only

Module description CI8 238

7.6 DAC8

Datasheet Version 1.5 (8 analog outputs)

Parameter	Value (typ./max.)	Remarks
Channels	8	
Configuration options	voltage source current source	each channel configurable separately
Output range	-10 V to +10 V 0 mA to 20 mA	(connected to min. 1 kΩ for voltage mode) (connected to max. 250 Ω for current mode)
Output frequency	5 kHz (max.)	
Analog bandwidth	5 kHz	-3 dB
Resolution	16 bit 15 bit	as voltage source as current source
Accuracy deviation	<0.1 %	
Output value upon power-up	0 V	
CAN-Bus	defined as per ISO 11898	
Isolation: CAN-Bus power supply analog outputs	 ±60 V ±60 V no isolation	to CHASSIS nominal; testing voltage: 300 V (10 s) nominal; testing voltage: 300 V (10 s) analog reference ground: CHASSIS
Supply voltage	10 V to 50 V DC	
Power consumption	6 W (typ.)	12 V supply, 23°C
Operating temperature	-20°C to 85°C	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 RPDOs in INT16, INT32, and FLOAT	
Dimensions (W x H x D)	35 x 111 x 90 mm 35 x 111 x 145 mm 41 x 128 x 145 mm 75 x 111 x 145 mm	CANSAS-DAC8 CANSAS-L-DAC8 CANSAS-K-DAC8, -K-DAC8-BNC (8TE) CANSAS-L-DAC8-V
Weight	300 g	for CANSAS-DAC8
Connection terminals	2x DSUB-15 8x BNC 8x ITT Veam 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)	outputs DAC8, -L-DAC8 –K-DAC8 –K-DAC8-V CAN (in/out) supply
Connection terminals for SL	2x DSUB-15 / 4 channels 2x DSUB-9 1x 6-pin LEMO (HGA.1B.306)	CANSAS-SL-DAC8-D CAN (in/out), power supply (alternatively) DC supply for all SL models

Module description DAC8 247

7.7 DCB8

Datasheet Version 1.5 (8 channel bridge amplifier)

Parameter	typ.	min. / max.	Remarks
Inputs	8		
Measurement modes	voltage bridge measurement strain gauge		
Anti-Aliasing-Filter	≤190 Hz		-3 dB, depending on sampling rate
Sampling rate		≤1 kHz	
Resolution	16 Bit		
Bandwidth	0 Hz to 190 Hz	200 Hz [2]	-3 dB
Connection terminals	4 plug DSUB-15, 2 channels per plug 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)		ACC/DSUB-B2 CANSAS-K-DCB8 and -L-DCB8 CAN (in / out), supply (alternatively) power supply
Connection terminals for SL inputs: CAN (in / out)	4 plug DSUB-15, 2 channels per plug 2 x DSUB- 9		ACC/DSUB-B2-IP65 only with CANSAS-SL-DCB8-D CANSAS-SL-DCB8-D-Protect supply (alternatively)
inputs:	8x 7 pin LEMO (HGG.1B.307)		only with CANSAS-SL-DCB8-L
CAN (in / out)	2x 10-pin LEMO (HGA.1B.310)		supply (alternatively)
DC power supply:	1x 6-pin LEMO (HGA.1B.306)		for all SL models

[2] Anti-aliasing: OFF

Parameter	typ.	min. / max.	Remarks
Voltage measurement			
Voltage input range	±10 V, ±5 V, ±2 V, ±1 V... ±5 mV		
Overvoltage strength		±40 V	long term
Input coupling	DC		
Input configuration	differential		
Input impedance	20 MΩ 9.5 MΩ	±1 %	differential (when Power ON) Power OFF
Gain uncertainty	0.02 %	≤0.05 %	of reading
	+20 ppm/K·ΔT_a	+80 ppm/K·ΔT_a	ΔT_a=|T_a -25°C| ambient temperature T_a
Offset drift	0.02 %	≤0.05 % ≤0.1 %	of range, in ranges: >± 50 mV ≤ ± 50 mV
	±0.06µV/K·ΔT_a	±0.3 µV/K·ΔT_a	range ≤ ± 10 V ΔT_a=|T_a –25°C| ambient temperature T_a
Common mode rejection ranges ±10 V to ± 50 mV ± 20 mV to ±5 mV	 92 dB 120 dB	 >84 dB >100 dB	common mode test voltage: ± 10 $V_=$
Noise (RTI)	0.4 μV_{rms} 14 nV/√Hz		bandwidth 0.1Hz to 190 Hz (RTI)

Parameter	typ.	min. / max.	Remarks
Bridge measurement			
Bridge measurement modes:	- full bridge - half bridge - quarter bridge		 5 V bridge excitation voltage only
Bridge input ranges	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ... ±0.5 mV/V ... ±1 mV/V ... ±2 mV/V		bridge excitation voltage: 10 V 5 V 2.5 V
Input impedance	20 MΩ 9.5 MΩ	±1 %	differential (only Power ON) Power OFF
Gain uncertainty	0.02 %	≤0.05 %	of reading
drift	+20 ppm/K·ΔT_a	+80 ppm/K·ΔT_a	$\Delta T_a=\|T_a -25°C\|$ ambient temperature T_a
Offset	0.01 %	≤0.02 %	of input range after automatic bridge balancing
drift	+16 nV/V/K·ΔT_a	+0.2 µV/V/K·ΔT_a	$\Delta T_a=\|T_a -25°C\|$ ambient temperature T_a
Bridge excitation voltage	10 V 5 V 2.5 V	±0.5 %	not with quarter bridge measure
min. bridge impedance max. bridge impedance	120 Ω, 10 mH full bridge 60 Ω, 5 mH half bridge 5 kΩ		
Internal quarter-bridge completion	120 Ω		optional 350 Ω
Cable resistance for bridges (without return line)	<6 Ω <12 Ω <24 Ω		10 V excitation 120 Ω 5 V excitation 120 Ω 2,5 V excitation 120Ω
General			
Isolation: CAN-Bus power supply input analog inputs	 ±60 V ±60 V no isolation		to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) analog reference ground: CHASSIS
Dimensions (W x H x D)	75 x 111 x 142 mm 81 x 128.4 x 145 mm 58 x 112.5 x 152mm		CANSAS-L-DCB8 CANSAS-K-DCB8 CANSAS-SL-DCB8-D, -Protect, CANSAS-SL-DCB8-L
Supply voltage	10 V to 50 V DC		
Power consumption	4 W to 18 W		
Operating temperature	-30°C to 85°C		

Module description DCB8 253

Parameter	Value (typ. / max)			Remarks
Sensor supply				
Configurations options	8 ranges			
Output voltage	Voltage	Current	Net	set globally, isolated on request

Parameter	Value (typ. / max)			Remarks
Sensor supply				
			power	
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 W	
	+10 V	300 mA	3.0 W	
	+12 V	250 mA	3.0 W	
	+15 V	200 mA	3.0 W	
	+24 V	120 mA	2.9 W	
	±15 V	190 mA	3.0 W	available on request[1] (only without isolation ; not with LEMO)
Short circuit protection	unlimited duration			to reference ground of the output voltage
Precision of output voltage	<0.25 % (typ.) <0.5 % (max.) <0.9 % (max.) <1 % (max.)			at the connection terminals, no load 25°C; 2.5 V to 24 V 25°C; 2.5 V to 24 V over entire temperature range [2] ±15 V
Adjustment of cable resistances with DCB8	3-line adjustment: SENSE line at return line (–VB: supply-ground)			Provided for 5 V and 10 V. Prerequisites: 1) symmetrical feed and return lines, 2) identical lines for all channels, 3) representative measurement at Channel 1
Efficiency	min. 40 % typ. 55 % typ. 50 % typ. 70 %			2.5 V 5 V, ..15 V 24 V ±15 V
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V, ..10 V, ±15 V 12 V, 15 V 24 V

The sensor supply module always makes only 7 of 8 selectable voltage ranges available:

- default case: all voltage ranges not isolated (standard ranges: +2.5 V to +24 V; ±15 V optional)
- upon request: all voltage ranges isolated, but only if the range ±15V is not included (only for SL with LEMO connectors)
- upon request: with range ±15 V instead of one other range, however all voltage ranges not isolated (not for SL with LEMO-connectors)

Description sensor supply 259

[1] With option ±15V the quarter bridge can't be measured, because the ¼ bridge pin is used for–15 V . Also the ground referenced current measurement no longer applies

[2] Precision has no effect of the accuracy of the bridge measurement.

7.8 DI16

Datasheet Version 1.4 (16 digital inputs)

Parameter	Value (typ. / max)	Remarks
Inputs	16	Common reference ground for each 2-channel-group. Each 2-channel-group isolated to other groups as well as to power supply and CAN-bus.
Contacts	2x DSUB-15 Phoenix terminal block 16x ITT Veam 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)	inputs CANSAS-DI16, -L- DI16 -K- DI16-DSUB -K-DI16-Ph, -L-DI16-Ph CANSAS-L-DI16-V CAN (in / out), supply (alternatively) supply
Contacts (SL)	2x DSUB-15 / 8 channels 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	inputs CAN (in / out), supply (alternatively) supply
Configuration possibilities	TTL or 24 V input voltage range	software-configurable
Sampling rate	10 kHz	
Input configuration	differential	isolated to power supply and channel-to-channel
Input current	max. 500 µA	limited by current supply (min. current 100 µA)
Switching threshold 5 V operation (TTL) 24 V operation	 V_{Lmax} = 0.8 V; V_{Hmin} = 2.0 V V_{Lmax} = 5.0 V; V_{Hmin} = 8.0 V	 typ. 1.7 V ± 200 mV 6.7 V ± 300 mV
CAN-Bus	defined as per ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	
Isolation: CAN-Bus power supply input digital inputs	 ±60 V ±60 V ±60 V	to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Overvoltage protection	±60 V	differential input voltage
Supply voltage	10 V to 50 V DC	
Power consumption	4 W (typ.)	12 V power supply, 23°C
Operating temperature	-30°C to 85°C	
Dimensions (W x H x D)	35 x 111 x 90 mm 35 x 111 x 145 mm 41 x 128 x 145 mm 41 x 128 x 145 mm 75 x 111 x 145 mm 152 x 111 x 145 mm 38 x 112.5 x 152 mm	CANSAS-DI16 CANSAS-L-DI16 CANSAS-K-DI16 CANSAS-K-DI16-DSUB CANSAS-L-DI16-Ph CANSAS-L-DI16-V CANSAS-SL-DI16-D
Weight	300 g	

Module description DI16 259

7.9 DO16

Datasheet Version 1.4(16 digital outputs)

Parameter	Value (typ./max.)	Remarks
Channels	16 (2 x 8)	Each 8-channel-group isolated to the other group as well as to power supply and CAN-bus. No isolation within bank. Separate voltage supply for each bank of 8 channels
Configuration options	Open-Drain Totem-Pole	configurable independently for each 8-bit channel group
Max. output level	5 V max. 30 V	internal supply external supply
Output current	High-level: 15 mA to 20 mA Low-level: 700 mA	Low-level: <0.4 V
Power-up default	High-impedance High	configured as Open-Drain configured as Totem-Pole
Switching time	100 µs	
CAN-Bus	defined according to ISO 11898	
Isolation: CAN-Bus Power supply input Digital outputs	 ±60 V ±60 V ±60 V	to CHASSIS nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Externally available power supply	5 V/ 30 mA per connector	available in addition to the output stages
Supply voltages	10 V to 50 V DC	
Power consumption	4 W (typ.)	12 V supply, 23 °C
Operating temperature	-30°C to 85°C	
Dimensions (W x H x D)	35 x 111 x 90 mm 41 x 128 x 145 mm 38 x 112.5 x 152 mm	CANSAS-DO16 CANSAS-K-D016 (8HP) CANSAS-SL-DO16-D
Weight	300 g	
Connection terminals	2x DSUB-15 PHOENIX spring cage terminal block 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	CANSAS-DO16 outputs CANSAS-K-DO16 outputs CAN (in/out) Supply
Connection terminals at SL	2x DSUB-15 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	outputs CAN (in/out), supply (alternatively) Supply

Module description DO16 263

7.10 DO8R, DO16R

Datasheet Version 1.5 (8 or 16 relay outputs)

Parameter	Value (typ./max.)	Remarks
Relays	8 16	DO8R DO16R
Relay specs: Switching current Switching power Switching voltage Switching time	 1 A @ 30 V DC (max.) 10 µA @ 10 mV DC (min.) 0.3 A @ 125 V AC (max.) 30 W (max.) 37.5 W (max.) 110 V DC 125 V AC < 8 ms	
Power-up default	all deactivated	
CAN-Bus	defined by ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 1 RPDO in INT16, INT32, and FLOAT	only with DO8R
Isolation: CAN-Bus power supply input	 ±60 V ±60 V	to CHASSIS nominal; testing: 300 V(10 s) nominal; testing: 300 V(10 s)
Supply voltage	10 V to 50 V DC	
Power consumption	4 W (typ.)	12 V supply, 23 °C
operating temperature	-30°C to 85°C	
Dimensions (W x H x D)	35 x 111 x 90 mm 35 x 111 x 145 mm 75 x 111 x 145 mm 81 x 128 x 145 mm 75 x 111 x 145 mm	CANSAS-DO8R CANSAS-L-DO16R CANSAS-L-DO16R-Ph CANSAS-K-DO16R (8TE) CANSAS-L-DO8R-V
Weight	300 g	
Connection terminals	2x DSUB-15 4x DSUB-15 8x ITT VEAM PHOENIX terminal block 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	outputs : DO8R -L-DO16R -L-DO8R-V -L-DO16R-Ph, K-DO16R CAN (in/out) supply

Module description DO8R, DO16R 266

7.11 IGN

Datasheet Version 1.1 (ignition angle measurement module)

Parameter	Value (typ. / max)	Remarks
Inputs	1 1 1	ignition signal crankshaft sensor reference signal inputs isolated from CAN-Bus, supply and mutually.t
Analog output	-10 V to +10V 0 V to 10 V	ignition signal -100° to +100° RPM 0 to 10000 RPM
Digital outputs	TTL	TTL-conditioned copy of the ignition signal and angle inputs
Sampling rate (CAN output)	1 Hz to 200 Hz	Averaging duration
Time resolution of measurement	333 ns	counter frequency 3 MHz (primary sampling rate)
Input pulse frequency	max. 600 kHz	
RPM range	100 RMP to 20000 RMP	
Adjustable signal delay	max. 10 ms	
Crankshaft sensor	36-1, 36-2, 60-1, 60-2, 36+1, 24-1 2 to 3600 cogs 1 pulse	with missing cog sensor with zero impulse sensor with 1 pulse per revolution
Input voltage range	±40 V	differential
Resolution ignition angle	0.1° 0.01°	on display on CAN
Resolution RPM	1 RPM 0.5 RPM	on Display on CAN
Resolution of data	12 Bit	
Input configuration	differential	pull-up to 5 V
Input impedance	1 MΩ	
Switching threshold	-40 V to +40 V	individually adjustable per channel
Hysteresis	0 V bis 40 V	individually adjustable per channel
Common mode input voltage	max. ±60 V	
Analog bandwidth	500 kHz	-3 dB (full power)
Integrated snapshot-mode	20 kHz to 3 MHz	
CMRR	70 dB (typ.), 50 dB (min.) 60 dB (typ.), 50 dB (min.)	DC, 50 Hz 10 kHz
Gain uncertainty	<1 %	23°C
Offset	<1 %	23°C
frequency stability	<100 ppm	aging <±5 ppm / year
CAN-Bus	defined by ISO 11898	
Isolation: CAN-Bus Versorgung analoge Eingänge	 ±60 V ±60 V ±60 V	gegenüber Gehäuse (CHASSIS) nominal; getestet: 300 V (10 s) nominal; getestet: 300 V (10 s) nominal; getestet: 100 V (10 s)
Overvoltage protection	±100 V	long-term
Sensor supply	+12 V (max 100 mA) +5 V (max 200 mA)	Reference: GND
Display	2 lines 0.2 s, 0.5 s, 1 s	alphanumerical frame rate
Supply voltages	10 V to 50 V DC	
Power consumption	4 W (typ.)	12 V Versorgung, 23°C

Parameter	Value (typ. / max)	Remarks
Operating temperature	-30°C to 85°C	
Dimensions (W x H x D)	205 x 115 x 45 mm	CANSAS-IGN
Weight	770 g	
Connection terminals	3xBNC 1x DSUB-15 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	inputs outputs CAN (in / out) power supply

Module description IGN 267

7.12 INC4

Datasheet Version 1.4 (4 incremental counter inputs)

Parameter	Value (typ. / max)	Remarks
Inputs	4 + 1 (9 tracks)	4 channels with 2 tracks (X, Y) each 1 index channel all fully conditioned inputs isolated from CAN-Bus and supply, but not mutually.
Measurement modes:	displacement, angle, events, time, frequency; velocity, RPMs	
Sampling rate (CAN output)	1 kHz / channel (max.)	
Time resolution of measurement frequency stability deterioration	33 ns <100 ppm <±5 ppm / year	counter frequency 32 MHz (primary sampling rate)
Resolution of data	16 bits	
Input configuration	differential	
Input impedance	100 kΩ	
Switching threshold	-8 V to +10 V	globally selectable in 0.1 V steps
Hysteresis	0,3 V to 4 V	globally selectable in 0.1 V steps
Input voltage range (differential)	±10 V ±30 V	linear range maximum, outside of linear range: max. non-linearity uncertainty: 300 ns
Common mode input voltage	max. ±30 V	
Analog bandwidth	500 kHz	-3 dB (full power)
Analog filter	bypass (without filter), 20 kHz, 2 kHz, 200 Hz	adjustable (globally for all channels) Butterworth, 2nd order
CMRR	70 dB (typ.), 50 dB (min.) 60 dB (typ.), 50 dB (min.)	DC, 50 Hz 10 kHz
Gain uncertainty	< 1 %	23°C
Offset	< 1 %	23°C
frequency stability	< 100 ppm	deterioration <±5 ppm / year
CAN-Bus	defined by ISO 11898	
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	
isolation: CAN-Bus power supply input analog input	 ±60 V ±60 V no isolation	to CHASSIS nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) analog reference ground: CHASSIS
Overvoltage protection	±60 V	long-term
Sensor supply	+5 V ±200 mA, 20 mA	Reference: GND
Supply voltages	10 V to 50 V DC	
Sensor supply voltage at CANSAS-L-INC4-V-SUPPLY	+2.5 V to +24 V	technical specs: Sensor supply module 427
Power consumption:	4 W (typ.)	12 V supply, 23°C
Operating temperature	-30°C to 85°C	
Dimensions (W x H x D)	35 x 111 x 90 mm 35 x 111 x 145 mm 41 x 128 x 145 mm 38 x 112.5 x 152 mm	CANSAS-INC4 CANSAS-L-INC4, -L-INC4-V CANSAS-C-INC4 (8TE) CANSAS-SL-INC4-L

Parameter	Value (typ. / max)	Remarks
	38 x 112.5 x 152 mm	CANSAS-SL-INC4-D
Weight	300 g	CANSAS-INC4
Connection terminals	2x DSUB-15 4x ITT VEAM 2x DSUB-9 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	Inputs: -INC4, -L-INC4 -L-INC4-V(-SUPPLY) -K-INC4 CAN (in / out), supply (alternatively) power supply
Connection terminals for SL inputs CAN (in/out)	 2x DSUB-15 2x DSUB-9	 CANSAS-SL-INC4-D power supply (alternatively)
inputs CAN (in/out) power supply	4x 7-pin LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	only CANSAS-SL-INC4-L power supply (alternatively) for all SL models

Module description INC4 286

7.13 ISO8

Datasheet Version 1.2 (8 differential analog inputs)

Parameter	Value (typ. / max)		Remarks
Inputs	8		4 channels on each DSUB-15 socket
Measurement modes: CANSAS-ISO8	voltage voltage with divider current thermocouples Pt100		configurable in blocks of 4 Standard-plug (CAN/DSUB-U4) Divider-plug (CAN/DSUB-U4D) Shunt-plug (CAN/DSUB-I4) Thermo-plug (CAN/DSUB-T4) Pt100-plug (CAN/DSUB-PT): 4 channels with contacts for 4-wire connection or voltage plug (CAN/DSUB-U)
CANSAS-K-ISO8-BNC, -L-ISO8-BNC	voltage with divider		BNC
CANSAS-K-ISO8-2T, -L-ISO8-T CANSAS-K-ISO8-3T	thermocouples		Thermo-plug 2 pin; IEC 584 (green) Thermo-plug 3 pin; IEC 584 (green)
Contacts	2x DSUB-15 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)		inputs CAN (in / out) supply
Sampling rate/channel	500 Hz (max.)		
Resolution	16 Bit		
Voltage input ranges:	±2 V, ±500 mV, ±100 mV ±50 V, ±10 V		with standard plug with divider plug (asymmetric, referenced to ground)
Current input ranges:	± 40 mA, ±10 mA, ±2 mA		with shunt plug (50 Ω)
Thermocouple input ranges	-200 to +1200°C		with thermo-plug , all common types
Pt100 input ranges	-200 to +600°C		with Pt100-plug, I = 0.3 mA
Isolation: analog inputs CAN-bus power supply input	 ±60 V ±60 V ±60 V		to enclosure (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Isolation channel-to-channel:	±60 V		nominal; testing: 300 V (10 s) for rated accuracy max. difference between two input pins of any channel
Overvoltage protection	±60 V (high-impedance during surge)		differential (long-term)
Input configuration	DC, differential		isolated form: enclosure, supply and CAN-bus
Input impedance (static)	10 MΩ 500 kΩ 50 Ω		voltage, thermo voltage with divider current
Input current static dynamic	4 nA (Type.)	40 nA (max.) 100 nA (max.)	 in-swung scanning state middle dynamic input current
Gain uncertainty:	<0.05 % <0.15 % <0.15 %		23°C with voltage plug with divider plug shunt plug
Gain drift	<75 ppm / K		
Offset	<0.02 %		across entire temperature range
Temperature uncertainty	<1 K		sensor: Type K at 20 °C throughout entire temperature range
Noise	50 µV pp	7 µV rms	range ±100 mV, Rsource = 50 Ω,

Parameter	Value (typ. / max)		Remarks
	25 mV pp	7 mV rms	sampling rate 2ms range ±10 mV (divider)
CMRR / IMR	> 100 dB (50Hz)		±50 V (channel - chassis) ±100 V (channel - channel)
Supply voltage	9 V to 32 V DC		
Power consumption::	<2.8 W (typ.)	<3.4 W (max.)	12 V, throughout entire temperature range
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D)	35 x 111 x 90 mm 75 x 111 x 145 mm 40 x 128 x 145 mm		CANSAS-ISO8 CANSAS-L-ISO8-BNC, -L-ISO8-T CANSAS-K-ISO8, K-ISO8-BNC, K-ISO8-T2, -K-ISO8-T3
Weight	300 g		

Module description ISO8 291

7.14 HCI8

Technical Specs Version 1.4 (8 isolated analog channels with high common mode voltage)

Parameter	typ.	max.	Remarks
Inputs	8		
Measurement modes	Voltage Current Resistor Thermocouples, RTD (Pt100)		
ampling rate/channel	≤1 kHz		
Bandwidth	440 Hz		-3 dB
Filter cutoff frequency Filter characteristics	1/6 of sampling rate		digital low-pass, Butterworth and Bessel, 2nd order
Connection terminals	5 terminals / channel (+IN, -IN +I, +PT, -PT)		PHOENIX FFKDS 3,81 spring clamp terminals

Voltage and current measurement				
Voltage input ranges	± 20 mV / ±50 mV / ±100 mV / ±200 mV / ±500 mV / ±1 V / ±2 V / ±5 V / ±10 V / ±20 V / ±60 V			
Current input ranges	±10 mA / ±20 mA		50 Ω internal shunt	
Gain uncertainty	<0.025 % <0.07 %	<0.05 % <0.15 %	voltage, 25 °C current	
Offset uncertainty	0.02%	≤0.05% ≤0.08%	of range range > ± 50 mV range ≤ ± 50 mV	
Non-linearity	<120 ppm		±10 V input range	
Gain drift		15 ppm/K 50 ppm/K	ranges ≤±2 V ranges ≥±5 V	over entire temperature range
Offsetdrift		1 µV/K	over entire temperature range	
Input voltage noise (RTI)		2 µVrms 12 µVpp	bandwidth 0.1 to 440 Hz range ±20 mV R_{source} = 0 Ω	
Channel isolation	>1 GΩ, <40 pF >1 GΩ, <10 pF		to system ground chanel-to-channel	
Crosstalk	>165 dB (50 Hz) >92 dB (50 Hz)		ranges ≤±2 V ranges ≥±5 V	R_{source} ≤100 Ω

Temperature measurement - Thermocouples			
Input ranges	R, S, B, J, T, E, K, L, N		per IEC 584
Resolution	0.025 K	< 0.028 K	dependent on type (16-bit)
Measurement uncertainty		< ±0.5 K	Type K, range: -150 °C to 1200 °C
Temperature drift	±0.02 K/K·ΔT_a		ΔT_a= |T_a -25 °C| ambient temp T_a
Uncertainty of cold junction compensation Drift of cold junction compensation	±0.001 K/K·ΔT_a	< ±0.5 K	ΔT_i= |T_i -25 °C| ambient temp T_i

Temperature measurement – Pt100		
Input ranges	-200 °C to +850 °C -50°C to +150°C	individual current sources, isolated

Temperature measurement – Pt100		
Resolution	0.016 K 0.003 K	input range: -200 to +850 °C (16-bit) input range: -50 to +150 °C (16-bit)
Measurement uncertainty	<±0.25 K < ±0.05 %	-200 °C to +850 °C, four-wire measurement plus measurement value
Temperature drift	±0.01 K/K·ΔT_a	ΔT_a=|T_a -25 °C|; ambient temp T_a
Sensor power supply (Pt100)	250 µA	

Parameter	Value (typ. / max)	Remarks
Resistor measurement		
Input range	0 Ω to 1000 Ω 0 Ω to 500 Ω 0 Ω to 250 Ω 0 Ω to 150 Ω	

General				
Parameter	**typ.**	**max.**	**Remarks**	
Isolation: (common mode) General Pollution degree test voltage to system ground Automotive Measurement category Working voltage transients, diff. overvoltage Supply network Measurement category Assessment voltage	 2 2300 V CAT I 800 V 500 V CAT II 300 V		per IEC (EN) 61010-1 1 min impulses per ISO 7637-2	
Overvoltage protection (differential)	±600 V ESD 2 kV Transient protection: automotive load dump ISO 7637, test impulse 6		diff. input voltage, 1 min. human body model Test impulse 6 Ri=30 Ω, td=300 µs, tr<60 µs	
IMR (isolation mode rejection)	>105 dB (50 Hz) 0.01 ppm/Hz 40 dB >70 dB (50 Hz) 0.12 ppm/Hz 18 dB		Ranges ≤ ±2 V < 1 MHz ≥ 1 MHz Ranges ≥ ±5 V < 1 MHz ≥ 1 MHz	R_{source} = 0 Ω
Input coupling configuration	DC differential, isolated		isolated from system ground (housing, CHASSIS, function ground)	
Input impedance	6.7 MΩ 1 MΩ 50 Ω		Ranges ≤ ±2 V Ranges ≥ ±5 V and with device deactivaed current input	
Input current normal at overload	 	 1 nA 1 mA	 under operating conditions |Vin| > 5 V for ranges < ±5 V or deactivated	
TEDS - Transducer Electronic DataSheets	conformant to IEEE 1451.4		upon request	

General			
Parameter	**typ.**	**max.**	**Remarks**
	Class II MMI		only when equipped with custom connectors
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 TPDOs in INT16, INT32, and FLOAT		from CANSAS version 1.6R12
Supply voltage		9 V to 50 V DC	common mode
Power consumption	4 W	< 5.5 W	depending on supply voltage and operating mode
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D), Weight	85 x 111 x 160 mm 70 x 111 x 154 mm 75 x 111 x 145 mm 960 g 790 g		with protrusions (CANSAS-HCI8) without protrusions (CANSAS-HCI8) CANSAS-L-HCI8 CANSAS-HCI8 CANSAS-L-HCI8

HCI8 292 module description

7.15 P8 (Pressure)

Datasheet Version 1.5 (8 pressure measurement inputs)

Parameter	Value (typ. / max.)	Remarks
Inputs	8	
Measurement modes:	absolute pressure relative pressure	
Sampling rate/ channel	1 kHz (max.)	
Resolution	16 Bit	

Absolute pressure measurement	Measurement uncertainty		Remarks
Input range			10°C to 60°C; input range determined by the built-in sensor; mounting position see
+0.5 bar to 10.0 bar	< 0.2 %	< 20 mbar	outline of description of the module 298.1
+0.5 bar to 3.5bar	< 0.2 %	< 7 mbar	
+0.8 bar to 1.2bar	< 0.2 %	< 12 mbar	
internal barometer	< 0.1 % abs.	< 1.2 mbar	
	< 0.1 %abs.	< 1.2 mbar	

Relative pressure measurement	Measurement uncertainty		Remarks
Input range			10°C to 60°C; uncertainty specs pertain to range
-0.3 bar to +0.3 bar	< 0.3 %	< 1.8 mbar	pressure sensor
-0.5 bar to +9.0 bar	< 0.2 %	< 21 mbar	derived by means of intern. barometer
-0.5 bar to +2.5 bar	< 0.25 %	< 8.2 mbar	“
-0.2 bar to +0.2 bar	< 0.6 %	< 2.4 mbar	“

Parameter	Value (typ. / max.)		Remarks
Medium hookup			
	quick-release nipples		designed for:
	5 stainless steel, perfluorine rubber (FFKM)[4]		gases, fuels, oils, water
Leak-free [3]	5 chrome-plated brass, FFKM		fuels
Non-leak-free	5 or 7,2, stainless, fluorine rubber (FPM, FKM)[5]		gases, oils, water
	5, brass, butadiene acrylonitrile rubber (NBR)[6]		gases
Mating cycles	1000		with regular lubrication
Overload protection			
	min.	**max.**	
Input ranges			
0 bar to +10.0bar		+15 bar	
0 bar to +3.5bar		+5 bar	
+0.8 bar to +1.2bar	+0.5 bar	+1.5 bar	
-0.3 bar to +0.3bar	-0.5 bar	+0.5 bar	
Material temperature:	0°C to +100°C Perfluorine rubber (FFKM)		The upper limits are determined by the pressure sensors.
	-15°C to +100°C Fluorine rubber (FPM, FKM)[4]		
	0°C to +100°C butadiene acrylonitrile rubber (NBR)[5]		Sealings not used in standard models
	0°C to +100°C Ethylene Propylene		

CANSAS-IP65-P8 fluid pressure measurement module					
Channel	**Range**	**Medium**	**Sensor**	**Module nipple**	**Recommended coupling (optional)**
1, 2	0..10bar	fuel	absolute pressure sensor (A10)	NW5, chrome-plated brass, Kalrez®-sealing, leakage-free	order code: CAN/21KLAD14MKC NW5, chrome-plated brass, Kalrez®-sealing, leakage-free
3,4,5	0..6bar	oil / water	absolute pressure sensor (A10)	NW7,8, stainless, Viton®-sealing, free passage	CAN/25KAAD14RVX NW5, stainless, Viton®-sealing, one-way flow
6,7,8	0..10bar	oil / water	absolute pressure sensor (A10)	NW5, stainless, Viton®-sealing, free passage	CAN/25KAAD14RVX NW5, stainless, Viton®-sealing, one-way flow

[1] Due to the effect of gravity on the oil column in its internal barometer, the sensors' high sensitivity can lead to offset errors if its position is changed. (For measurements of relative pressure, this can be compensated using the Tare function)

[3] Leak-free signifies that the nipples come with a valve which closes automatically when the tube is disconnected (useful for liquids).

[4] Brand name: Kalrez®

[5] Brand names: Viton®, Technoflon®, Fluorel®,

[6] Brand names: Perbunan® , Chemigum®, Hycar®, Krynac®, Elaprim®, JSR-N®

CANSAS-L-P8-G4 gas pressure measurement module, Type IV					
Channel	**Range**	**Medium**	**Sensor**	**Module nipple**	**Recommended coupling (optional)**
1-8	0..10bar	Gas	absolute pressure sensor (A10)	NW5, brass, Perbunan®-sealing, free passage	CAN/21KFAD14MPX: NW5, brass, Perbunan®-sealing, free passage

General technical specs			
Parameter	**Value (typ. / max.)**		**Remarks**
Isolation: CAN-Bus	 ±50 V		 to housing (CHASSIS)
Supply voltage	10 V to 50 V DC		
Power consumption:	5 W (typ.)	8 W (max.)	24 V, over entire temperature range
Operating temperature	-15°C to 60°C		ambient temperature
Shock resistance	50 g pk		over 5 ms
Dimensions (W x H x D)	111 x 115 x 145 mm 122 x 128 x 145 mm 129 x 110 x 188 mm		CANSAS-L-P8 (dimensions without terminals) CANSAS-K-P8 CANSAS-IP65-P8 (incl. mounting angle)
Weight	approx. 1.3 kg approx. 1.8 kg		CANSAS-L-P8 CANSAS-IP65-P8
Connection terminals	8 x pressure nipples 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81) AMPHENO (C091 4-pin M) AMPHENO (C091 3-pin M)		Inputs: CANSAS-L-P8 CAN (in / out) Supply CANSAS-IP65-P8 CAN (in / out) Supply

Remarks:

- Accuracy ratings pertain to state after transients.
- If the module is subjected to accelerations, the inertia will cause measurement errors with the sensitive sensors.

Module description P8 298

7.16 PWM8

Datasheet Version 1.4 (8 digital outputs)

Parameter	Value (typ. / max)	Remarks
Channels	8 (2 x 4 channels)	4-channel-group isolated to the other group as well as to supply and CAN-bus. No isolation within a group. Separate voltage supply for both 4-channel-groups.
Output configuration	Open-Drain output TTL-output	each channel has one open-drain and one TTL output.
PWM frequency	30 Hz to 10 kHz	common setting for each channel group
Time resolution of Measurement	33 ns	counter frequency 32 MHz (primary sampling rate)
Resolution	60 ns 90 ns 160 ns 290 ns 550 ns	10 kHz to 500 Hz 500 Hz to 250 Hz 250 Hz to 120 Hz 120 Hz to 60 Hz 60 Hz to 30 Hz
Duty cycle	0 % to 100 %	
Output level (max.)	TTL: 5 V Open-Drain: <30 V	internal supply external supply
External usable supply	5 V/ 30 mA per plug (VCC_1_4 and VCC_5_8)	Additionally to supply of outputs
Output current	TTL (High-level): <10 mA TTL (Low- level): <10 mA Open-Drain (Low- level): <1400 mA	
Switching time	TTL: < 6/ 16 ns open-drain: < 10/ 20 µs	
CAN-Bus	defined as per ISO 11898	
Isolation: CAN-Bus supply analog output	 ±60 V ±60 V ±60 V	to housing (Chassis) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Supply voltage	10 V to 50 V DC	
Power consumption	4 W (typ.)	@12 V, 23°C
Operating temperature	-30°C to 85°C	
Connectors	2x DSUB-15 8x ITT VEAM 2x DSUB-9 PHOENIX (MC 1,5/4STF-3,81)	outputs: PWM8, -K-PWM8 -L-PWM8-V CAN (in/out) supply
Dimensions (W x H x D)	35 x 111 x 90 mm 81 x 128 x 145 mm 75 x 111 x 145 mm	CANSAS-PWM8 CANSAS-K-PWM8 CANSAS-L-PWM8-V

Module description PWM8 313

7.17 SC16

Datasheet Version 1.4 (16 differential analog inputs)

Parameter	Value (typ. / max)	Remarks
Channels	16	4-channel groups on 4x DSUB-15
Measurement mode (DSUB) CANSAS-SC-16, -L-SC16, -K-SC16	voltage ≤60 V voltage ≤10 V thermocouple, RTD (Pt100) current	with divider plug (ACC/DSUB-U4D) standard plug (ACC/DSUB-U4) thermo plug (ACC/DSUB-T4) with shunt plug (ACC/DSUB-I4)
Meas. mode (SL DSUB) CANSAS-SL-SC16-D -SL-SC16-L-SUPPLY	voltage ≤10 V	ACC/DSUB-U4-IP65
Meas. mode (SL LEMO) CANSAS-SL-SC16-L, -SL-SC16-L-SUPPLY	voltage ≤10 V RTD (Pt100) current	 with external shunt
Meas.mode (TK-plug) CANSAS-L-SC16-2T, -K1-SC16-2T	thermocouple type-K	
TEDS - Transducer Electronic DataSheets	conform IEEE 1451.4 Class II MMI	ACC/DSUB-TEDS-U4, TEDS-U4D ACC/DSUB-TEDS-U4-IP65 ACC/DSUB-TEDS-T4, -TEDS-T4-IP65 ACC/DSUB-TEDS-I4, -TEDS-I4-IP65
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	
Sampling rate CANSAS-SC-16 Sampling rate, temperature CANSAS-SC-16	 max. 500 Hz (2 ms) / channel max. 1 Hz (1 s) / channel	maximum allowable input signal frequency: 100 Hz recommended maximum for optimized noise reduction; filter: 12 Hz (-3 dB); -60 dB @ 50 Hz no restrictions for input noise frequency (except for narrow band 0,5 Hz to 12 Hz)
Bandwidth with compensation filter	28 Hz sampling rate / 7	at sampling rate 500 Hz (2 ms), 200 Hz (5 ms) 100 Hz (10 ms) to 2 Hz (500 ms)
Resolution	16 bit	

Voltage			
Parameter	**typ.**	**min. / max.**	**Remarks**
Range	±10 V, ±5 V ±2 V, ±1 V ±500 mV, ±200 mV , ±100 mV ±60 V, ±20 V		 with divider-plug
Gain uncertainty	 <0.025 % <0.075 % <0.075 %	 <0.05 % <0.15 % <0.15 %	23°C with standard connector with divider connector (only SC-16) shunt connector
Gain drift	30 ppm/K(typ.) 50 ppm/K(typ.)	60 ppm/K(max.) 90 ppm/K(max.)	range ≤±50 V range ≥±10 V
Offset	<0.02 %		over entire temperature range

Voltage		
Linearity uncertainty	<50 ppm	range ±10 V
Current mode		
Range	±40 mA, ±20 mA, ±10 mA, ±4 mA, ±2 mA	with shunt connector (50Ω)

Temperature			
Thermocouples			
Range	-200°C to +1200°C		Typ: R, S, B, J, T, E, K, L, N (max. one type per configuration)
Temperature uncertainty	±0.2 K	<±0.5 K	Typ: J, T, K, E, L (other types: uncertainties of voltage measurements) @ 20°C over entire input range sample rate SC16: ≥1s with imc plug ACC/DSUB-T4
Drift	±0.02 K/K·ΔT_a		ΔT_a=|T_a -25°C|; ambient temp: T_a
Uncertainty of cold junction Compensation		<±0.15 K <±0.5 K	with imc plug ACC/DSUB-T4 with CANSAS-K1-SC16-2T
Drift of cold junction	±0.001 K/K·ΔT_j		ΔT_j = |T_j -25°C| could junction T_j
RTD mode (Pt100)			
Range	-200°C to +850°C		(reference current: 410 µA, int. calibrated) Use of thermo-plug provides complete set of terminals for full 4-wire connection scheme; mixed configuration with thermocouples supported
Uncertainty		<±0.2 K <±0.05 %	-200°C to 850 °C, four-wire connection plus percentage of reading
Drift		±0.01 K/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a

General			
Parameter	**typ.**	**min. / max.**	**Remarks**
Block isolation: CAN-bus DC supply input	 ±60 V ±60 V		each function block to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Max. common-mode input voltage	±40 V		analog input to case (CHASSIS) nominal rating
Channel isolation: CAN-bus supply	 ±15 V ±40 V		max. voltage between any two arbitrary input pins of different channels; for specified accuracy fault protection
Overvoltage protection	±40 V		differential channel input voltage (long-term)
Input configuration	DC, differential		isolated to: case, supply and CAN-bus
Input impedance (static)	10 MΩ 1 MΩ 50 Ω		voltage mode ≤10 V voltage mode ≥20 V (divider) current mode (Shunt plug)
Input current : static dynamic	 2 nA (typ.) 0.2 mA (typ.)	 25 nA (max.) 20 mA (max.)	dynamic input currents: scanner-device! settled current at time of sampling peak dynamic input current (typ. @100 mV, max. @10 V) average dynamic input current

General			
Parameter	**typ.**	**min. / max.**	**Remarks**
on overvoltage condition	20 nA (typ.) 0.1 µA	2 µA (max.) 1 µA	(typ. @100 mV, max. @10 V) |Vin| >15 V ;or device powered-down
Noise	25 µV pk-pk 10 mV pk-pk 0.5 K pk_pk 6 µV pk-pk	5 µV rms 2 mV rms 0.08 K rms	sample-rate: 2 ms, R_s = 50 Ω range ±100 mV range ±20 V temperature mode: Thermocouple Type K sample-rate: 1 s, R_s = 50 Ω
Source impedance	5 kΩ (max.)		of sensor or signal source
Cable length (signal-input)	200 m (max.)		100 pF / m
Crosstalk (channel to channel)	<-105 dB		60 Hz, 100 Ω source impedance, range ±100 mV
CMRR / IMR	100 dB (50 Hz)		Common-Mode reference: frame (CHASSIS) all other channels: CHASSIS
Supply voltage	10 V to 50 V DC		
sensor supply voltage (optional)	2.5 V to 24 V		technical specs Sensor supply module 427
Power requirements:	2.6 W (typ.)	<3.0 W (max.)	12 V DC, over full temperature range
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D), weight	55 x 111 x 90 mm; 300 g 55 x 111 x 145 mm; 850 g 41 x 128 x 145 mm; 500 g 78 x 112.5 x 152 mm 58 x 112.5 x 152 mm 55 x 111 x 90 mm 55 x 111 x 145 mm 58 x 112.5 x 152 mm 78 x 112.5 x 152 mm		CANSAS-SC16 CANSAS-L-SC16, -L-SC16-2T CANSAS-K-SC16, -K1-SC16-2T (=3HE/8TE) CANSAS-SL-SC16-L CANSAS-SL-SC16-D with optional sensor supply CANSAS-SC16-SUPPLY CANSAS-L-SC16-SUPPLY CANSAS-SL-SC16-L-SUPPLY CANSAS-SL-SC16-D-SUPPLY
Terminal connection	4x DSUB-15 or 16x 2-pol. TK-connector 2x DSUB-9 PHOENIX (MC 1,5 /4STF-3,81)		inputs only for thermocouple measurement type K CAN (in / out), power supply (alternatively) DC power supply
Terminal connection SL inputs: CAN (in / out): inputs: CAN (in / out): DC power supply:	 4x DSUB-15 2x DSUB-9 16x LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)		 CANSAS-SL-SC16-D, (SUPPLY) power supply (alternatively) CANSAS-SL-SCI16-L, (SUPPLY) power supply (alternatively) power supply (for all SL models)

Module description SC16 318

7.18 SCI8, SCI16

Datasheet Version 1.4 (16/8 differential analog inputs)

Parameter	Value (typ. / max)	Remarks
Channels CANSAS-SCI16 CANSAS-SCI8	 16 8	 4-channel groups on 4x DSUB-15 4-channel groups on 2x DSUB-15
Measurement mode (DSUB) CANSAS-SCI8, SCI16	voltage ≤60 V thermocouple, RTD (Pt100) current	standard-plug (ACC/DSUB-U4) thermo-plug (ACC/DSUB-T4) shunt-plug (ACC/DSUB-I4)
Meas. mode (SL DSUB) CANSAS-SL-SCI8-D -SL- SCI16-D	voltage ≤60 V thermocouple, RTD (Pt100) current	ACC/DSUB-U4-IP65 ACC/DSUB-T4-IP65 ACC/DSUB-I4-IP65
Meas. mode (SL LEMO) CANSAS-SCI8, SCI16	voltage ≤60 V RTD (Pt100) current	 with external shunt
Meas. mode (TK-Buchse) CANSAS-L-SCI8(16)-2T, -K-SCI8(16)-2T	thermocouple type-K	
Meas. mode (BNC) CANSAS-SCI8(16)-BNC	voltage ≤60 V	
TEDS - Transducer Electronic DataSheets	conform IEEE 1451.4 Class II MMI	ACC/DSUB-TEDS-U4, TEDS-UD4 ACC/DSUB-TEDS-U4-IP65 ACC/DSUB-TEDS-T4, -TEDS-T4-IP65 ACC/DSUB-TEDS-I4, -TEDS-I4-IP65
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 4 PDOs in INT16, INT32, and FLOAT	
Sampling rate CANSAS-SCI16 CANSAS-SCI8 Sampling rate, temperature CANSAS-SCI16 CANSAS-SCI8	 max. 500 Hz (2 ms) / channel max. 1 kHz (1 ms) / channel max. 1 Hz (1 s) / channel max. 2 Hz (500 ms) / channel	maximum allowable input signal frequency: 100 Hz 150 Hz recommended maximum for optimized noise reduction; filter: 12 Hz(-3dB); -60dB @ 50 Hz no restrictions for input noise frequency (except for narrow band 0,5 Hz to 12 Hz)
Bandwidth CANSAS-SCI16 CANSAS-SCI8	with compensation filter 23 Hz sampling rate / 7 42 Hz sampling rate / 7	at sampling rate 500 Hz (2 ms), 200 Hz (5 ms) 100 Hz (10 ms) … 2 Hz (500 ms) 1 kHz (1 ms), 500 Hz (2 ms) 200 Hz (5 ms) … 5 Hz (200 ms)
Resolution	16 bit	

Voltage			
Parameter	**Value (typ. / max)**		**Remarks**
Range	±60 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V, ±500 mV, ±200 mV, ±100 mV		
Gain uncertainty	<0.025 % <0.075 %	<0.05 % <0.15 %	23°C with standard connector shunt connector
Gain drift	30 ppm/K (typ.) 50 ppm/K(typ.)	60 ppm/K(max.) 90 ppm/K(max.)	range ≤±50 V range ≥±10 V
Offset	<0.02%		over entire temperature range
Linearity uncertainty	<50 ppm		range ±10 V

Voltage		
Parameter	**Value (typ. / max)**	**Remarks**
Current mode		
Range	±40 mA, ±20 mA, ±10 mA, ±4 mA, ±2 mA	with shunt connector (50 Ω)

Temperature			
Thermocouples	-200°C to +1200°C		Typ: R, S, B, J, T, E, K, L, N (max. one type per configuration)
Temperature uncertainty	±0.2 K	<±0.5 K	Typ: J, T, K, E, L (other types: uncertainties of voltage measurements) @ 20°C over entire input range sample rate SCI16: ≥1s and SCI8 ≥0,5s with imc plug ACC/DSUB-T4
Drift	±0.02 K/K·ΔT_a		ΔT_a=|T_a -25°C|; ambient temp: T_a
Uncertainty of cold junction compensation		< ±0.15K	with imc plug ACC/DSUB-T4
Drift of cold junction	±0.001K/K·ΔT_j		ΔT_j = |T_j -25°C| could junction T_j
RTD mode (Pt100)			
Range	-200°C to +850°C		(reference current: 410µA, int. calibrated) Use of thermo-plug provides complete set of terminals for full 4-wire connection scheme; mixed configuration with thermocouples supported
Uncertainty		<±0.2 K <±0.05 %	-200°C to 850 °C, four-wire connection plus percentage of reading
Drift		±0.01 K/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a

General			
Parameter	**Value (typ. / max)**		**Remarks**
Block isolation: CAN-bus DC supply input	 ±60 V ±60 V		each function block to case (CHASSIS) nominal; testing: 300 V (10 s) nominal; testing: 300 V (10 s)
Max. common-mode input Voltage CANSAS-SCI8, SCI16	 ±60 V		analog input to case (CHASSIS) nominal rating; testing: 300 V (10 s)
Channel isolation: CANSAS-SCI8, SCI16	 ±60 V		max. voltage between any two arbitrary input pins of different channels; for specified accuracy nominal rating testing: 300 V (10 s)
Overvoltage protection CANSAS- SCI8, SCI16	 ±60 V		differential channel input voltage (long-term)
Input configuration	DC, differential		isolated to: case, supply and CAN-bus
Input impedance (static)	10 MΩ 1 MΩ 50 Ω		voltage mode ≤ 10 V voltage mode ≥ 20 V (divider) current mode (Shunt plug)
Input current : CANSAS- SCI8, SCI16 static	 1.5 nA (typ.)	 15 nA (max.)	dynamic input currents: scanner-device! settled current at time of sampling

General			
Parameter	**Value (typ. / max)**		**Remarks**
dynamic	0.1 mA (typ.)	1.5 mA (max.)	peak dynamic input current (typ. @100 mV, max. @10 V)
on overvoltage condition	10 nA (typ.)	1 µA (max.)	average dynamic input current (typ. @100 mV, max. @10 V)
		1.5 mA	|Vin| >17 V in range ≤±10 V
Noise			sample-rate: 2 ms, R_s = 50 Ω
	25 µV pk-pk	5 µV rms	range ±100 mV
	10 mV pk-pk	2 mV rms	range ±20 V
	0.5 K pk_pk	0.08 K rms	temperature mode: Thermocouple Type K
	6 µV pk-pk		sample-rate: 1s, R_s = 50 Ω
Source impedance	5 kΩ (max.)		of sensor or signal source
Cable length (signal-input)	200 m (max.)		100 pF / m
Crosstalk (channel to channel			60 Hz, 100 Ω source impedance,
SCI8, SCI16	<-105 dB		range ±100 mV
CMRR / IMR	100 dB (50 Hz)		Common-Mode reference: frame (CHASSIS) all other channels: CHASSIS
Supply voltage	10 V to 50 V DC		
sensor supply voltage (optional)	2.5 V to 24 V		technical specs Sensor supply module 427
Power requirements:			12 V DC, over full temperature range
CANSAS-SCI8	2.8 W (typ.)	<3.3 W (max.)	
CANSAS-SCI16	9.0 W (typ.)	<10.5 W (max.)	
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D), weight	55 x 111 x 90 mm, 300 g		CANSAS-SCI16
	35 x 111 x 90 mm, 340 g		CANSAS-SCI8
	55 x 111 x 145 mm, 850 g		CANSAS-L-SCI16, L-SCI16-2T
	35 x 111 x 145 mm		CANSAS-L-SCI8
	41 x 128 x 145 mm, 500 g		CANSAS-K -SCI8, K-SCI8(16)-2T, -K-SCI8(16)-BNC (=3HE/8TE)
	58 x 112.5 x 152 mm		CANSAS-SL-SCI8-L
	78 x 112.5 x 152 mm		CANSAS-SL-SCI16-L
	38 x 112.5 x 152 mm		CANSAS-SL-SCI8-D
	58 x 112.5 x 152 mm		CANSAS-SL-SCI16-D
			with optional sensor supply
	55 x 111 x 90 mm		CANSAS-SCI16-SUPPLY
	55 x 111 x 90 mm		CANSAS-SCI8-SUPPLY
	55 x 111 x 145 mm		CANSAS-L-SCI16-SUPPLY
	55 x 111 x 145 mm		CANSAS-L-SCI8-SUPPLY
	41 x 128 x 145 mm, 500 g		CANSAS-K -SCI8(16)-SUPPLY (=3HE/8TE)
	58 x 112.5 x 152 mm		CANSAS-SL-SCI8-L-SUPPLY
	78 x 112.5 x 152 mm		CANSAS-SL-SCI16-L-SUPPLY
	58 x 112.5 x 152 mm		CANSAS-SL-SCI8-D-SUPPLY
	78 x 112.5 x 152 mm		CANSAS-SL-SCI16-D-SUPPLY
Connection terminals	4x DSUB-15		inputs (CANSAS-SCI16)
	2x DSUB-15		inputs (CANSAS-SCI8)
	or		
	8(16)x 2 TK plug		only thermocouples type-K
	2x DSUB-9		CAN (in / out), power supply (alternatively)
	PHOENIX (MC 1,5 /4STF-3,81)		DC power supply
Connection terminals for SL			
Inputs:	4x DSUB-15		CANSAS-SL-SCI16-D, (SUPPLY)
	2x DSUB-15		CANSAS-SL-SCI8-D, (SUPPLY)
CAN (in / out):	2x DSUB-9		power supply (alternatively)

General		
Parameter	**Value (typ. / max)**	**Remarks**
Inputs:	16x LEMO (HGG.1B.307) 8x LEMO (HGG.1B.307)	CANSAS-SL-SCI16-L, (SUPPLY) CANSAS-SL-SCI8-L, (SUPPLY)
CAN (in / out):	2x 10-pin LEMO (HGA.1B.310)	power supply (alternatively)
DC power supply:	1x 6-pin LEMO (HGA.1B.306)	for all SL types

Module description SCI8, SCI16 318

7.19 UNI8

Datasheet Version 1.5 (8 differential analog inputs)

Parameter	Value (typ. / max)	Remarks
Inputs	8	differential, separate inputs
Measurement modes (DSUB):	- voltage measurement - voltage measurement with adjusted supply - current measurement - Resistor - thermocouples (mounted with and without contact to GND) - Pt100 in 3- and 4-wire configuration - bridge-sensor - bridge: strain gauge	with shunt connector (ACC/DSUB-I2) or single ended
Measurement modes (LEMO):	- voltage measurement - voltage measurement with adjusted supply - current measurement - thermocouples (mounted with and without contact to GND) - Resistor - Pt100 in 3- and 4-wire configuration - bridge-sensor - bridge: strain gauge	single-ended or with external shunt
Connection terminals	8x round plugs ITT VEAM: CAN/UNIST-7-3 or CAN/UNIST-7-6 or 4x DSUB-15 2x DSUB-9 PHOENIX (MC 1.5/4STF-3.81)	Inputs, CANSAS-K-UNI8 and –L-UNI8 3 mm core 6 mm core ACC/DSUB-UNI2 CAN (in / out), supply (alternatively) power supply
Connection terminals for SL inputs CAN (in/out) inputs CAN (in/out) DC power supply	4 plug DSUB-15, 2 channels per plug 2x DSUB- 9 8x 7 pin LEMO (HGG.1B.307) 2x 10-pin LEMO (HGA.1B.310) 1x 6-pin LEMO (HGA.1B.306)	ACC/DSUB-B2-IP65 only with CANSAS-SL-UNI8-D power supply (alternatively) only with CANSAS-SL-UNI8-L power supply (alternatively) for all SL models
Sampling rate/channel	≤1 kHz	
Resolution	16 bit	
Bandwidth	0 Hz to 200 Hz	-3 dB; Filter OFF
	0 Hz to 190 Hz	-3 dB; with AAF-filter

Voltage measurement		
Parameter	**Value (typ. / max)**	**Remarks**
Voltage input ranges	±60 V, ±20 V, ±10 V, ±5 V, ±2 V, ±1 V... ±5m V	
Input configuration	DC, differential	
Overvoltage protection	±80 V	permanent channel to chassis
Input impedance	1 MΩ 20 MΩ	differential >±10 V ≤±10 V

Voltage measurement			
Parameter	**Value (typ. / max)**		**Remarks**
Gain: uncertainty	0.02 %	≤0.05 %	of reading
Drift	+20 ppm/K·ΔT_a	+80 ppm/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a
Offset: 0.02 % ≤0.05 % ≤0.06 %			of range, in ranges: >±50 mV ≤±50 mV
Drift	±60 µV/K·ΔT_a ±0.06 µV/K·ΔT_a	±100 µV/K·ΔT_a ±0.3 µV/K·ΔT_a	>±10 V ≤±10 V ΔT_a=|T_a -25°C|; ambient temp: T_a
Common mode rejection ranges ±60V...±20V ±10V...±50mV ±20mV...±5mV	62 dB 92 dB 120 dB	>46 dB >84 dB >100 dB	common mode test voltage: ±50 V ±10 V ±10 V
Noise	0.4 μV_{rms} 14 nV/√Hz		bandwidth 0,1 Hz to 220Hz (RTI)

Current measurement			
Input ranges	±50 mA, ±20 mA, ±10 mA, ,.., ±1 mA		shunt: 120 Ω internally or 50 Ω shunt in terminal plug
Over load protection		±60 mA	permanent
Input configuration	single-ended differential		120Ω interner Bürdenwiderstand 50Ω im Stecker
Gain: uncertainty	0.02 %	≤0.06% ≤0.1%	of reading plus uncertainty of 50Ω shunt
Drift	+20 ppm/K·ΔT_a	+95 ppm/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a
Offset: uncertainty	0.02 %	≤0.05 %	of range
Drift	±0.05 nA/K·ΔT_a	±0.5 nA/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a

Bridge measurement			
Parameter	**Value (typ. / max)**		**Remarks**
Bridge measurement modes:	full bridge half bridge quarter bridge		2,5V and 5V bridge excitation voltage only
Input ranges	±1000 mV/V, ±500 mV/V, ±200 mV/V, ±100 mV/V ... ±0,5 mV/V ... ±1 mV/V ... ±2 mV/V		bridge excitation voltage: 10 V bridge excitation voltage: 5 V bridge excitation voltage: 2,5 V
Input impedance	20 MΩ	±1 %	differential, full bridge
Gain: uncertainty	0.02 %	≤0.05 %	of reading
Drift	+20 ppm/K·ΔT_a	+80 ppm/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a
Offset: uncertainty	0.01 %	≤0.02 %	of input range after automatic bridge balancing
Drift	+16 nV/V/K·ΔT_a	+0.2 µV/V/K·ΔT_a	ΔT_a=|T_a -25°C|; ambient temp: T_a
Bridge excitation voltage	10 V 5 V	±0.5 %	Not for quarter bridge measurement
Cable impedance for bridges (without return line)		<8 Ω <16 Ω	10 V bridge voltage 120 Ω 5 V bridge voltage 120 Ω

Temperature measurement			
Thermocouple measurement			
Parameter	**Value (typ. / max)**		**Remarks**
Input ranges	J, T, K, E, N, S, R, B, L nach IEC 584		resolution: ca. 0.1K
Uncertainty	≤± 1 K		sensor type K at 20°C over total temperature range (Pt100 inside of connector)
Input impedance	20 MΩ	± 1 %	differential
RTD-measurement			
Input range	-200°C to 850°C		resolution: ca. 0.016 K
Uncertainty		≤0.2 K +0.02 % +0.01 K/K·ΔT_a	4-wire measurement of reading $\Delta T_a = \lvert T_a$ -25°C$\rvert$; ambient temp: T_a
Sensor current	1.23 mA		

Parameter	Value (typ. / max)	Remarks
Resistor measurement		
Input range	0 Ω to 800 Ω	

General technical specs			
Parameter	**Value (typ. / max)**		**Remarks**
Isolation: CAN-bus power supply input analog inputs	 ±60 V ±60 V no isolation		to housing (CHASSIS) nominal; testing:300 V (10 s) nominal; testing:300 V (10 s) analog reference ground: CHASSIS
Supply voltage	10 V to 50 V DC		DC
Power consumption:	8 W (typ.) 15 W (typ.)	10 W (max.) 20 W (max.)	24 V, over total temp. range for externally supplied sensors
Operating temperature	-30°C to 85°C		
Dimensions (W x H x D)	75 x 111 x 145 mm 81 x 128.4 x 145 mm 58 x 112.5 x 152 mm		without plugs CANSAS-L-UNI8, -L-UNI8-DSUB, -L-UNI8-LEMO CANSAS-K-UNI8, -K-UNI8 -DSUB CANSAS-SL-UNI8-D; -PROTECT, -SL-UNI8-L
Weight	ca. 900 g		

A model variant of UNI8 can be ordered which is equipped with a 350 Ω resistor instead of the 120 Ω resistor (internal quarter bridge completion). In that case, the resistance in a quarter bridge measurement can be as low as 350 Ω. However, this makes current measurement via the internal resistor impossible. Current measurement is then only possible with the help of an externally connected 50 Ω resistor.

For the model with DSUB plugs, a connector with a built-in 50 Ω resistor for current measurement is available.

Module description UNI8 333.

Sensor supply				
Parameter	**Value (typ. / max)**			**Remarks**
Configurations options	8 ranges			
Output voltage	Voltage	Current	Net power	set globally, isolated on request
	+2,5 V	580 mA	1.5 W	
	+5,0 V	580 mA	2.9 W	
	+7,5 V	400 mA	3.0 W	
	+10 V	300 mA	3.0 W	
	+12 V	250 mA	3.0 W	
	+15 V	200 mA	3.0 W	
	+24 V	120 mA	2.9 W	
	±15 V	190 mA	3.0 W	available on request[1] (only without isolation)
Short circuit protection	unlimited duration			to reference ground of the output voltage
Precision of output voltage	<0.25 % (typ.) <0.5 % (max.) <0.9 % (max.) <1 % (max.)			at the connection terminals, no load 25 °C; 2.5 V to 24 V 25 °C; 2.5 V to 24 V over entire temperature range [2] ±15 V
Adjustment of cable resistances with UNI8	3-line adjustment: SENSE line at return line (–VB: supply-ground)			Provided for 5 V and 10 V. Prerequisites: 1) symmetrical feed and return lines, 2) identical lines for all channels, 3) representative measurement at Channel1
Efficiency	min. 40 % typ. 55 % typ. 50 % typ. 70 %			2,5 V 5 V, ..15 V 24 V ±15 V
Max. capacitive load	>4000 µF >1000 µF >300 µF			2.5 V, ..10 V, ±15 V 12 V, 15 V 24 V

The sensor supply module always makes only 7 of 8 selectable voltage ranges available:

- default case: all voltage ranges not isolated (standard ranges: +2,5 V to +24 V; ±15 V optional)
- upon request: all voltage ranges isolated, but only if the range ±15 V is not included (only for SL with LEMO connectors)
- upon request: with range ± 15V instead of one other range, however all voltage ranges not isolated (not for SL with LEMO-connectors)

Description sensor supply 347

[1] With option ±15V the quarter bridge can't be measured, because the ¼ bridge pin is used for–15V . Also the ground referenced current measurement no longer applies

[2] Precision has no effect of the accuracy of the bridge measurement for UNI8.

7.20 µ-CAN - V1/V4

Technical Specs Version 1.3 (1 or 4 differential analog inputs)

Parameter	typ.	min. / max.	Remarks
Channels	1 4		µ-CANSAS-V1 µ-CANSAS-V4
Measurement modes:	voltage voltage with divider		Input: +IN_1V, -IN_COM Input: +IN_60V, -IN_COM
Sampling frequency/ channel	2 kHz		
Analog bandwidth	840 Hz		-3 dB, Filter OFF
AD-conversion	24 Bit		
Input ranges	±1 V, ±500 mV, ±200 mV, ±100 mV ±60 V, ±20 V, ±10 V ±5 V, ±2 V		Input: +IN_1V Input: +IN_60V
Sensor supply	5 V, 10 V		max 210 mW, short-circuit-protected: 1 s
Isolation	60 V 500 V		long-term 10 s
Max. sustainable voltage	40 V / 100 V 100 V		Input: +IN_1V long-term / 1 s Input: +IN_60V long-term
Input configuration	DC, differential		Isolation to: frame, power supply and CAN-Bus
Input impedance	5 MΩ 10 kΩ 900 kΩ		Input: +IN_1V Input: +IN_1V for voltage surge, or deactivated Input: +IN_60V
Gain uncertainty	<0.05 %		of measured value
Gain drift	2 ppm/K 3.5 ppm/K	10 ppm/K 30 ppm/K	ranges ≤±1 V ranges ≥±2 V
Offset	0.01 %		of input range
Offset drift	0.8 µV/K 4.4 µV/K	2 µV/K 20 µV/K	ranges ≤±1 V ranges ≥±2 V
Noise	1.6 µVrms 115 µVrms		Range: ±100 mV Range: ±2 V Sampling rate: 2 kHz, R_{Source} = 0 Ω
IMR (isolation mode rejection)	> 120 dB (50 Hz) > 100 dB (50 Hz)		ranges ≤±1 V ranges ≥±2 V R_{Source} = 0 Ω
Sensor supply	5 V, 10 V		max. 210 mW, short-circuit proof 1 s
Accurracy of sensor supply	<5 %		over entire temperature range
Supply voltage	9 V to 50 V DC		
Power consumption	typ 1 W typ 4 W	max 1.5 W max 4.5 W	µ-CANSAS-V1 µ-CANSAS-V4
Operating temperature	-40°C to 120°C		
Dimensions (W x H x D)	40 x 20 x 60 mm 55 x 63 x 70 mm / 104 mm / 89 mm		(without interconnections) µ-CANSAS-V1-AS µ-CANSAS-V4-AS /D (with interconnections) µ-CANSAS-V1-AS µ-CANSAS-V4-AS
Weight	0.08 kg 0.26 kg		µ-CANSAS-V1-AS µ-CANSAS-V4-AS
Connection terminals Sensor	1x 8-pin Phoenix strip terminal (MPT0,5/8)		µ-CANSAS-V1-AS

Parameter	typ.	min. / max.	Remarks
CAN , Supply	1x 22-pin Autosport Type: AS212-35SN 1x 6-pin Autosport Type: AS208-35PA 1x 6-pin Autosport Type: AS208-35PA 1x 6-pin Autosport Type: AS208-35SA		µ-CANSAS-V4-AS µ-CANSAS-V1-AS µ-CANSAS-V4-AS CAN IN µ-CANSAS-V4-AS CAN OUT
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 1 PDO in INT16, INT32, and FLOAT		only with µ-CANSAS-V1
TEDS - Transducer Electronic DataSheets	conform IEEE 1451.4 Class II MMI		

Module description µ-CANSAS-V1 355 and µ-CANSAS-V4 375.

7.21 µ-CAN - T1/T4

Technical Specs Version 1.3 (1 or 4 differential analog inputs)

Parameter	typ.	min./ max.	Remarks
Channels	1 4		µ-CANSAS-T1 µ-CANSAS-T4
Measurement modes:	Thermocouples B, E, J, K, N, R, S, T		Input: +IN_1V, -IN_COM with µ-CANSAS-T4 standard Type K
Sampling frequency/ channel	100 Hz		
Analog bandwidth	20 Hz		-3 dB
AD-conversion	24 Bit		
Isolation:	60 V 500 V		long-term 10 s
Max. sustainable voltage:	40 V / 100 V		long-term / 1s
Input configuration	DC, differential		isolation to: frame, power supply and CAN-Bus
Input impedance	5 MΩ 10 kΩ		 for voltage surge, or deactivated
Measurement uncertainty	<±0.6 K		Type: J, T, K, E (for all other types, the voltage measurement uncertainties apply; see Technical Specs µ-CANSAS-T1)
Temperature drift	±0.024 K/K·ΔT_a		$\Delta T_a = \lvert T_a - 25°C \rvert$ ambient temperature T_a
Uncertainty of cold junction compensation	<±0.3 K		tightly sealed screw connection
Drift of cold junction	±0.005 K/K ΔT_j		$\Delta T_j = \lvert T_j - 25°C \rvert$ cold junction temp. T_j
Supply voltage	9 V to 50 V DC		
Power consumption:	typ. 1 W typ. 4 W	max. 1.5 W max. 4.5 W	µ-CANSAS-T1 µ-CANSAS-T4
Temperature range	-40°C to 120°C		
Dimensions (W x H x D)	 40 x 20 x 60 mm 55 x 63 x 70 mm		(without interconnections) µ-CANSAS-T1-AS µ-CANSAS-T4-AS
Weight	0.08 kg 0.25 kg		µ-CANSAS-T1-AS µ-CANSAS-T4-AS
Connection terminals Sensor CAN , Power supply	 1x 8-pin Phoenix strip terminal (MPT0,5/8) 4x thermocouple socket Omega PCC-SMP 1x Autosport AS208-35PA 1x 6-pin Autosport (Type: AS208-35PA) 1x 6-pin Autosport (Type: AS208-35SA)		 µ-CANSAS-T1-AS µ-CANSAS-T4-AS µ-CANSAS-T1-AS µ-CANSAS-T4-AS CAN IN µ-CANSAS-T4-AS CAN OUT
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 1 PDO in INT16, INT32, and FLOAT		only with µ-CANSAS-T1
TEDS - Transducer Electronic DataSheets	conform IEEE 1451.4 Class II MMI		

Module description µ-CANSAS-T1 363 and µ-CANSAS-T4 376

7.22 µ-CAN - B1/B4

Technical Specs Version 1.3 (1 or 4 differential analog inputs)

Parameter	Value (min./ max.)	Remarks
Channels	1 4	µ-CANSAS-B1 µ-CANSAS-B4
Measurement modes:	full bridge, half bridge	dR/R at –IN max 0,7 input: +IN_1V, -IN_COM
Sampling frequency/ channel	2 kHz	
Analog bandwidth	840 Hz	-3 dB, Filter OFF
AD-conversion	24 bit	
Input ranges:	±200 mV/V, ±100 mV/V, ±50 mV/V, ±20 mV/V, ±10 mV/V, ±5 mV/V, ±2 mV/V, ±1 mV/V, ±0.5 mV/V	
Bridge supply:	5 V	DC; max 210 mW, short-circuit protection 1 s
Isolation:	60 V 500 V	long-term 10 s
Max. sustainable voltage:	40 V / 100 V	long-term / 1 s
Min. bridge impedance	120 Ω	I_{max}=42 mA
Input impedance	5 MΩ 10 kΩ	for voltage surge, or deactivated
Gain uncertainty	<0.1 %	of measured value
Offset of input range	<0.02 % <2 µV/V	±200 mV/V to ±10 mV/V < ±10 mV/V
Offset drift	0.04 µV/V/K	
Noise	0.32 µVrms	full bridge, dR/R=0
IMR	0.004 µV/V / V	50 Hz
Supply voltage	9 V to 50 V DC	
Power consumption:	typ. 1 W, max 1.5 W typ. 4 W, max 4.5 W	µ-CANSAS-B1 µ-CANSAS-B4
Temperature range	-40°C to 120°C +125 °C (max.)	operating temperature interior module temperature (components)
Dimensions (W x H x D)	 40 x 20 x 60 mm 55 x 63 x 70 mm 104 mm 89 mm	(without interconnections) µ-CANSAS-B1-AS µ-CANSAS-B4-AS /D (with interconnections) µ-CANSAS-B1-AS µ-CANSAS-B4-AS
Weight	0.08 kg 0.26 kg	µ-CANSAS-B1-AS µ-CANSAS-B4-AS
Connection terminals Sensor CAN , Supply	 1x 8-pin Phoenix strip terminal (MPT0,5/8) 1x 37-pin Autosport Type: AS214-35SN 1x 6-pin Autosport Type: AS208-35PA 1x 6-pin Autosport Type: AS208-35PA 1x 6-pin Autosport Type: AS208-35SA	 µ-CANSAS-B1-AS µ-CANSAS-B4-AS µ-CANSAS-B1-AS CAN OUT µ-CANSAS-B4-AS CAN IN µ-CANSAS-B4-AS CAN OUT
CANopen® mode	"CiA® DS 301 V4.0.2" and "CiA® DS 404V1.2" supports 1 PDO	only with µ-CANSAS-B1 in INT16, INT32, and FLOAT
TEDS - Transducer Electronic DataSheets	conform IEEE 1451.4 Class II MMI	

Module description µ-CANSAS-B1 365 and µ-CANSAS-B4 377.

7.23 µ-CAN - HUB4

Technical Specs Version 1.3 (HUB for connecting up to four 1-channel µ-CANSAS modules)

Parameter	Value (min./ max.)	Remarks
Connections	4x 6-pin Autosport Type: AS208-35SA	CAN (in) and power supply for µ-CANSAS modules with µ-CANSAS-HUB4-AS
	2x 6-pin Autosport Type: AS208-35PA/SA	CAN (in / out), power supply with µ-CANSAS-HUB4-AS
Isolation		to frame (CHASSIS)
CAN-Bus, power supply	±60 V	nominal; tested at 500 V (10 s)
Analog inputs	±60 V	nominal; tested at 500 V (10 s)
Supply voltage	9 V to 50 V DC	
Power consumption	1 W	module not connected
Operating temperature	-40°C to 120°C	
Dimensions (B x H x T)	70 x 70 x 30 mm	without interconnections
Weight	200 g	

Module description µ-CANSAS-HUB4 378

7.24 Sensor SUPPLY module

Version 1.1

For CANSAS C8 387, CI8 389, SCI8 414, SCI16 414, SC16 411 and INC4-V-SUPPLY 401 optional

(Optional for model long and cassette CANSAS-SC16)

Order code: CAN/SEN-SUPPLY

The sensor supply module always makes only 7 of 8 selectable voltage ranges available:

- default case: all voltage ranges not isolated (standard ranges: +2.5 V to +24 V; ±15 V optional)
- upon request: all voltage ranges isolated, but only if the range ±15 V is not included (only for SL with LEMO connectors)
- upon request: with range ±15V instead of one other range, however all voltage ranges not isolated (only for C8, CI8, not for SL with LEMO-connectors)

Parameter	Value (typ. / max.)			Remarks
Configuration options	8 ranges			
Output voltage	voltage	current	net power	globally selected, isolated on request (not for LEMO)
	+2.5 V	580 mA	1.5 W	
	+5.0 V	580 mA	2.9 W	
	+7.5 V	400 mA	3.0 W	
	+10 V	300 mA	3.0 W	
	+12 V	250 mA	3.0 W	
	+15 V	200 mA	3.0 W	
	+24 V	120 mA	2.9 W	
	±15 V	190 mA	3.0 W	available on request for C8, CI8 (then only non isolated; not for LEMO)
Short-circuit protection	unlimited duration			to output voltage reference ground
Output voltage accuracy				at terminal plugs, no load
	<0.25 % (typical)			25°C; 2.5 V to 24 V
	<0.5 % (max.)			25°C; 2.5 V to 24 V
	< 0.9 % (max.)			full temperature range
	<1 % (max.)			±15 V
Deviation control of lead impedance	3-wire control: SENSE lead as feedback (-VB is supply ground)			available for 5V and 10V requirements: 1) balanced cables 2) identical cables on all channels 3) representative measurement with channel 1
Efficiency	typ. 55 %			5V, to 15 V
	typ. 50 %			24 V
	typ. 70 %			±15 V
	min. 40 %			2.5 V
Capacitive load (max.)	>4000 µF			2,5 V, 10 V, ±15 V
	>1000 µF			12 V, 15 V
	>400 µF			24 V
Operating temperature	-30°C to 85°C			

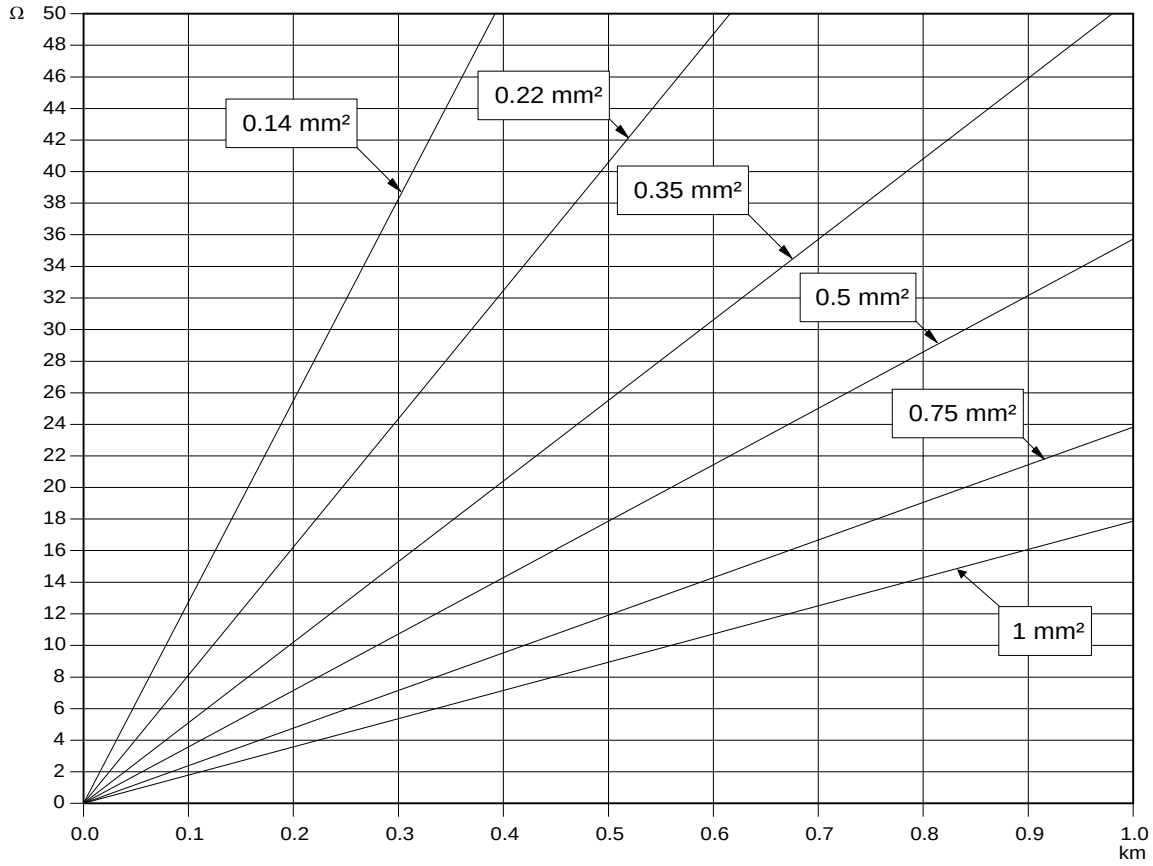
7.25 Synchronization line

Technical specs of the CANSAS modules' synchronization line

Parameter	Value (typ. / max)		Test conditions
High-level output voltage (“Master mode”)	4,75 V	5,5 V	
Low-level output voltage (“Master mode”)		0,55 V	@ I = 25 mA
High-level output current (“Master mode”)		25	
High-level Input Voltage (“Slave mode”)	4,0 V		
Low-level Input Voltage (“Slave mode”)		0,8 V	
input leakage current		100 µA	
sync-frequency	1 Hz		±100ppm

7.26 Tables and diagrams

7.26.1 Cable resistance as function of length and cross-section



Nomogram to determine cable resistance as function of one way distance and cross-section of copper cables

7.27 Accessories

7.27.1 DSUB-screw terminals for measurement inputs

All plugs are 15-pin connection blocks made for direct connection to the CANSAS sockets CON1 and CON2. For attaching the lines, there are screw terminals inside the plug enclosure.

Measurement	Comments	Order-#
Voltage	voltage measurement with 4 differential channels.	ACC/DSUB-U4 CAN/DSUB-U4 for ISO8
	voltage measurement with CANSAS-C12 (without divider) for 6 differential channels	CAN/DSUB-U6 for C12
Voltage with divider	voltage measurement with CANSAS-C12 with 1:100 Dividers for 6 differential channels, for connection of voltages up to 50V	CAN/DSUB-U6D for C12
	voltage measurement with CANSAS-ISO8 with 1:100 divider for 4 differential channels, for connection of voltages up to 50V	ACC/DSUB-U4 CAN/DSUB-U4D for ISO8
Current	current measurement (0..40 mA) with CANSAS-C12 with 50Ω (0,1%) shunt equipped with 6 differential channels	CAN/DSUB-I6 for C12
	current measurement (0..40 mA) with 50Ω (0,1%) shunt equipped for 4 differential channels	ACC/DSUB-I4 CAN/DSUB-I4 for ISO8
	current measurement with 50Ω (0,1%) shunt equipped for 2 differential channels	ACC/DSUB-UNI8-I
Thermocouples	direct connection of 6 thermocouples to CANSAS-C12. In the terminal connector, an isothermal plate and a PT100 for cold junction compensation are built in	CAN/DSUB-T6 for C12
	direct connection of 4 thermocouples. In the terminal connector, an isothermal plate and a PT100 for cold junction compensation are built in.	ACC/DSUB-T4 CAN/DSUB-T4 for ISO8
PT100	connection of 4 Pt100 measurement resistors	CAN/DSUB-Pt100 for C12 and ISO8 ACC/DSUB-T4
Measurement bridges	bridge measurement for two channels with CANSAS-BRIDGE2	ACC/DSUB-B1
	bridge measurement for two channels with CANSAS-UNI8	ACC/DSUB-B2
Incremental encoder inputs	connection of 4 incremental encoders CANSAS-INC4 connection of 4 incremental encoders with current signal	ACC /DSUB-ENC4 ACC/DSUB-ENC4-IU
Analog outputs	4 analog output channels for CANSAS-DAC8	ACC /DSUB-DAC4
Digital inputs	8 digital inputs for connection to CANSAS-DI16	CAN/DSUB-DI
Digital outputs	8 digital outputs for connection to CANSAS-DO16	ACC /DSUB-DO8
Relay outputs	four relays for connection to CANSAS-DO8R	ACC /DSUB-REL4
Voltage, current, bridge, resistor, temperature	all-purpose connector for two channels to CANSAS-UNI8: voltage, current, resistance, bridge, thermocouples, PT100	ACC/DSUB-UNI8-UNI
PWM8	4 digital outputs for connection to CANSAS-PWM8	ACC/DSUB-PWM4

7.27.2 CAN-bus accessories

	Order-#	Comments
CAN-bus connection cable with built-in terminators	CAN/CABLE-TERMI	2 m long 1:1 cable; one side with 9-pin DSUB-socket, one side with corresponding plug, built-in CAN-bus terminators for connecting CANSAS to the configuration interface in the PC
CAN-bus connection cable	CAN/CABLE-TYPEE2	2 m long 1:1 cable; one side with 9-pin DSUB-socket, one side with corresponding plug
CAN-bus terminators	CAN/TERMI	2 CAN-bus terminators, cable; one with 9-pin DSUB-socket, one with corresponding plug
CANSAS reset plug	CAN/RESET	CANSAS configuration plug with 9-pin DSUBsocket; terminator not included, therefore only used in conjunction with CAN/CABLE-TERMI!
Cables for CANSAS-IP65-P8		
Adapter kit for configuration	CAN/Adapter-AMPH-CON	Terminal adapter-kit for configuration of a CANSAS-IP65-P8 unit. Consists of cable set with 3-pin Amphenol plug for CANSAS Power socket, 4-pin Amphenol, Y-adapter with DSUB-plug and 9-pin sockets. DSUB-9 plug terminated with Reset
Adapter for CAN connection	CAN/Adapter-AMPH-4	Terminal adapter for CANSAS-IP65-P8 (4-pin Amphenol plug for DSUB-9 terminal) for connection to CAN/Y-cable
CAN-Bus connection cable	CAN/Adapter-AMPH-CAN	4-pin Amphenol to 4-pin Amphenol (female-female) connection cable for pressure expansion

7.27.3 CANSAS power supply accessories

	Order-#	Comments
CANSAS power supply	CAN/POWER SUPPLY - 230	Power supply unit: input 240V_{AC}, output 15V_{DC} with mains cable and Phoenix-plug for CANSAS POWER-socket; Supplies one CANSAS unit!
	CAN/POWER SUPPLY-110	Input 110V_{AC}, output 15V_{DC} with mains cable and adapter for CANSAS POWER-jack for the supply of one CANSAS-module.
Connection plug for CANSAS POWER-socket	CAN/POWER-PLUG	4-pin Phoenix-plug and cover for connecting to CANSAS POWER-socket
Cables for CANSAS-IP65-P8		
Adapter for current supply	CAN/Adapter-AMPH-3	Terminal adapter for CANSAS-IP65-P8 (3-pin Amphenol plug for CANSAS Power socket) for connection to the current supply for CANSAS CAN/Power Supply Unit-230
Power connection cable	CAN/AMPH-3-POWER	Supply cable for pressure expansion 3-pin Amphenol to 3-pin Amphenol (female-female)

7.27.4 DSUB connector for incremental sensors with current signals

Accessory: connector for incremental sensors with currents signals for use with an incremental encoder interface

Parameter	typ.	min. / max.	Test conditions / Remarks
usable with	CRPL/ENC-4 CRPL/HRENC-4 C-Series/ENC-4 CANSAS/INC4		DSUB-15 connector
inputs	4 + 1		differential, non isolated
input coupling	DC		
range 4 basic channels: 1 index channel:	 ±12 µ A ±24 µ A		
sensitivity 4 basic channels: 1 index channel:	 Vout = - 0,2 V / µA Vout = - 0,1 V / µA		
input impedance 4 basic channels: 1 index channel:	 200 kΩ 100 kΩ		
voltage output	differential		differential signal „+Vout“ – „-Vout“ analyzed by the INC-4 module
output level	approx. 0 V to 5 V +Vout = 2,5 V - 0,2 V / µA -Vout = 2,5 V		basic channels
analog bandwidth 4 basic channels: 1 index channel:	 80 kHz 50 kHz		
supply: auxiliary power	 5 V, 5 mA, 25 mW		supplied by the INC-4 module: DSUB15(14) VCC
connector plug	DSUB-15 with screw clamp in the connector housing		

Pin configuration and power supply

8.1 CAN-Bus connectors

By default, the connector to CAN is with DSUB9 433.

CANSAS-SL modules are equipped with LEMO connectors 436.

µ-CANSAS units use Autosport 437 connectors.

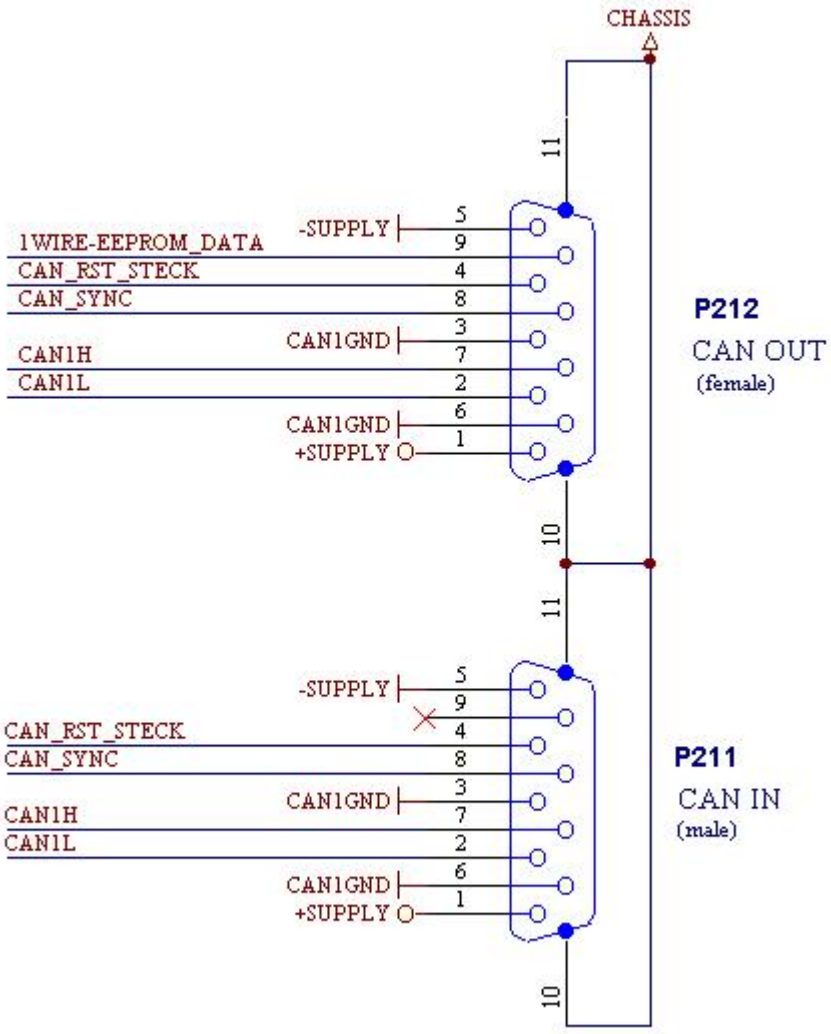
8.1.1 Standard module with DSUB9 CAN Bus connector

Below is shown the pin configuration of the CAN-bus plug/socket set (CAN IN and CAN OUT).
A general description of the CAN-bus can be found in CAN-Bus description 35.

Notes on the hardware versions

Hardware Version 1: Valid for all devices shipped prior to mid-2003. (C12,ISO8, INK4, Bridge2, DI16, DO16, DAC8). In these modules, there is no *IWIRE-EEPROM_DATA* connection; CAN IN is thus identical to CAN OUT in terms of the pin configuration.

Hardware Version 2: Valid for all UNI8, P8, DO16R, C8 and all -L- modules. For all other modules, please check in the software under General/ Version/ Hardware whether this is the version. Generally it only is for modules shipped since late-2003.



PIN	Signal	CiA®-description	Use in CANSAS
1	+CAN_SUPPLY		CANSAS-specific: + CANSAS voltage supply. The module can be supplied via this connector (and Pin 5).
2	CAN_L	dominant low bus line	connected as per CiA®
3	CAN_GND	CAN Ground	connected as per CiA®. CAN-Bus reference ground.
4	CAN_RST_STECK		CANSAS-specific: CANSAS Reset (for startup with Reset Connector). The Reset plug has a shortcut to PIN 3 (GND).
5	-CAN_SUPPLY		CANSAS-specific: - CANSAS voltage supply (Negative pole of supply respectively. 0V).
6	GND	CAN Ground	connected to Pin 3, as per CiA®
7	CAN_H	dominant high bus line	connected as per CiA®
8	CAN_SYNC		CANSAS-specific: Additional line for a sync signal (1 Hz). Generally 5 V to CAN Ground.
9	1Wire EEPROM		CANSAS-specific: EEPROM information about mounting position (when used in a rack) Exists only at female CAN-OUT plug P212. Pin 9 at male CAN-In plug is "not connected". Pin 9 is the positive pin of the EPROM. The corresponding minus-pole must be connected to the chassis/shield (10/11) of the DSUB-plug. The EPROM is not inside the module, but can be connected external.

The two 9-pin plugs are connected to each other 1:1; thus, all connections can be fed through to the next CANSAS module, but not Pin 9.

8.1.1.1 CAN-Bus wiring

Unless 9-line cables are used for the CAN-Bus, observe the following: Pins 2 and 7 are absolutely necessary for transfer on the CAN-Bus. The CAN-Bus ground is also necessary. This may not be obvious, but consider that differentially transmitted signals require a reference, for which reason a line connected to the CAN-Bus ground must also be included. Either Pin 3 or Pin 6 can be used for this purpose. Situations can also arise in which the CAN-ground is not needed: for instance, in a vehicle, where it is possible to access Chassis potential anywhere, instead of using a line to Pin 3. In this case, Chassis simply replaces the line to Pin 3.

Other lines can be included as required, for example a synchronization line or supply line.

Note also when using DSUB-plugs and the cables that there is a maximum current which DSUB-plugs can carry. This particularly applies to the DSUB-plugs on the CANSAS-modules and the internal connection of all of this plug's pins. The current should not exceed approx. 1A. It may be necessary to use a correspondingly high supply voltage for the modules, or the separate green terminal for the supply.

Also give regard to the cables' cross-sections. The CAN-cables with 9-pin, DSUB-plug which are included in the standard package are not designed to carry large currents.

8.1.1.2 Notes for the use of CANcabs

Problem: Pins 4 and 9 are used in CANSAS for Reset and OneWire EEPROM. When a CANcabs extra cable from any of the companies Vector, dSPACE or KVASER is used, it results in duplicate pin assignment, since these pins are also used in those cases.

Remedy: The contacts Pin 4 and Pin 9 in the CAN-connector must be disconnected from their leads to the CANcabs!

This applies to the following CANcabs:

Pin	251 1050	251opto 1050opto DNopto	251 fiber	1041 opto	252 1053 1054	1054 opto	10011 opto	5790c (single wire)	5790c opto
1									
2	CAN Low	CAN Low	CAN Low	CAN Low	CAN Low	CAN Low	CAN Low	N.C.	N.C.
3	GND	V_{GND}	V_{GND}	V_{GND}	GND	V_{GND}	V_{GND}	GND	V_{GND}
4	RL	N.C.	N.C.	Split	RL	N.C.	RL	R100	R100
5	Shield								
6									
7	CAN High								
8									
9	N.C.	N.C.	VB+ 6-36V	VB+ optional 11-18V	N.C.	VB+ optional 11-18V	VB+ optional 16-32V	$V_{\_Batt}$	VB+ optional 11-18V

RL: reserved, may not be connected

8.1.1.3 Specification of components used

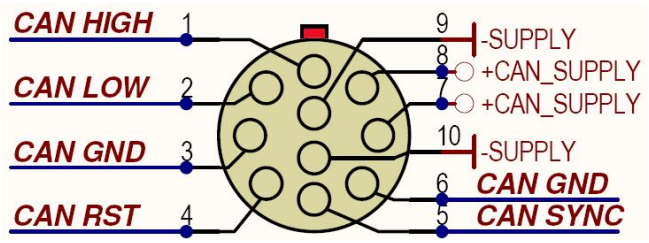
In CANSAS, the following components are used for the CAN-connection. Use this as a reference for the purpose of especially critical applications, e.g. in connection with bit-timing.

CAN-Controller: DSP TMS320LF2407A (Texas Instruments)
Oscillator Type: SG8002JFPCM-10M Hz (Epson, crystal oscillator, 10M Hz, -40 +85°C,±100ppm);
CAN transceiver: PCA82C250 (Philips)
Slope resistor: 1kΩ

8.1.2 SL modules CAN-Bus connectors

Below is shown the pin configuration of the CAN-bus plug/socket set (CAN IN and CAN OUT) at the CANSAS modules with SL housing. Only differences to the standard CANSAS modules are described here.
A general description of the CAN-bus can be found in Chapter "Startup" 35 of this documentation.

8.1.2.1 CAN-Bus pin configuration and contact wiring



10-pin LEMO (HGA.1B.310)

PIN	Signal	CiA®-description	Use in CANSAS
1	CAN_HIGH	dominant high bus line	connected as per CiA®
2	CAN_LOW	dominant low bus line	connected as per CiA®
3	CAN_GND	CAN Ground	connected as per CiA®. CAN-Bus reference ground.
4	CAN_RST_STECK		CANSAS-specific: CANSAS Reset (for startup with Reset Connector). The Reset plug has a shortcut to PIN 3 (GND).
5	CAN_SYNC		CANSAS-specific: Additional line for a sync signal (1 Hz). Generally 5 V to CAN Ground.
6	CAN_GND	CAN Ground	connected to Pin 3, as per CiA®
7, 8	+CAN_SUPPLY		CANSAS-specific: + CANSAS voltage supply +10 V..+50V. The module can be supplied via this connector (and Pin 9 + 10).
9, 10	-SUPPLY		CANSAS-specific: - CANSAS voltage supply (Negative pole of supply respectively. 0V).

Both 10-pin sockets are directly connected. In that way all circuit points can be connected through to the next CANSAS module.

Unless 10-line cables are used for the CAN-Bus, observe the following: Pins 1 and 2 are absolutely necessary for transfer on the CAN-Bus. The CAN-Bus ground is also necessary. This may not be obvious, but consider that differentially transmitted signals require a reference, for which reason a line connected to the CAN-Bus ground must also be included. Either Pin 3 or Pin 6 can be used for this purpose. Situations can also arise in which the CAN-ground is not needed: for instance, in a vehicle, where it is possible to access Chassis potential anywhere, instead of using a line to Pin 3. In this case, Chassis simply replaces the line to Pin 3.

Other lines can be included as required, for example a synchronization line or supply line.

Note also when using LEMO-plugs and the cables that there is a maximum current which LEMO-plugs can carry. This particularly applies to the LEMO-plugs on the CANSAS-modules and the internal connection of all of this plug's pins. The current should not exceed approx. 4,5A. It may be necessary to use a correspondingly high supply voltage for the modules, or the separate terminal for the supply.

Also give regard to the cables' cross-sections.

8.1.3 µ-CANSAS CAN-Bus connections with

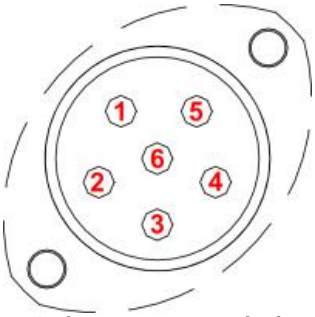
Below is the pin configuration of the µ-CANSAS modules' CAN-Bus connector. Connections are made via 6-pin Autosport terminals of the type AS208-35SA (CAN IN) and AS208-35PA (CAN OUT). Here, only the deviations from the normal housing types are presented.
For a general description of the CAN-bus refer to CAN-Bus description 35.

☞ **Import note!**

Per **default** µ-CANSAS modules µ-CANSAS-V1-AS, µ-CANSAS-T1-AS and µ-CANSAS-B1-AS come **without an internal terminator resistor**. This means to work connected directly to a µ-CANSAS-HUB4-AS they need extra terminators. If you order the module with integrated terminator, you wont need extra terminators when connected to a HUB4. In this case such a module can only be used as the last module in the CAN-Bus, since it necessarily terminates the CAN-Bus.

8.1.3.1 CAN-Bus pin configuration and contact wiring

PIN	Signal	CiA® description	Use in CANSAS
1	+CAN_SUPPLY	dominant high bus line	CANSAS-specific: + CANSAS supply +9…+50 V. The module is supplied via the pins +CAN_SUPPLY and –SUPPLY.
2	-SUPPLY		CANSAS-specific: - CANSAS power supply (minus contact: 0V).
3	CAN_LOW	dominant low bus line	Connected as specified by CiA®
4	CAN_HIGH	dominant high bus line	Connected as specified by CiA®
5	CAN_RESET		CANSAS-specific: CANSAS Reset. Must be jumpered with CAN_GND for a reset.
6	CAN_GND	CAN Ground	Connected as per CiA®. CAN-bus reference ground



6-pin Autosport terminal type AS208-35

Pins 3 and 4 are absolutely necessary for transmission on the CAN-Bus, as well as the CAN-Bus ground. According to specifications, the differential signals require a reference, for which reason a CAN-Bus ground connection is also needed. For this purpose pin 6 can be used. There are situations where the CAN ground is not necessary: for example, on board vehicles, if instead of a line to pin 6 it is possible to make contact with anywhere on the chassis. In that case, the chassis is a substitute for the line to pin 6.

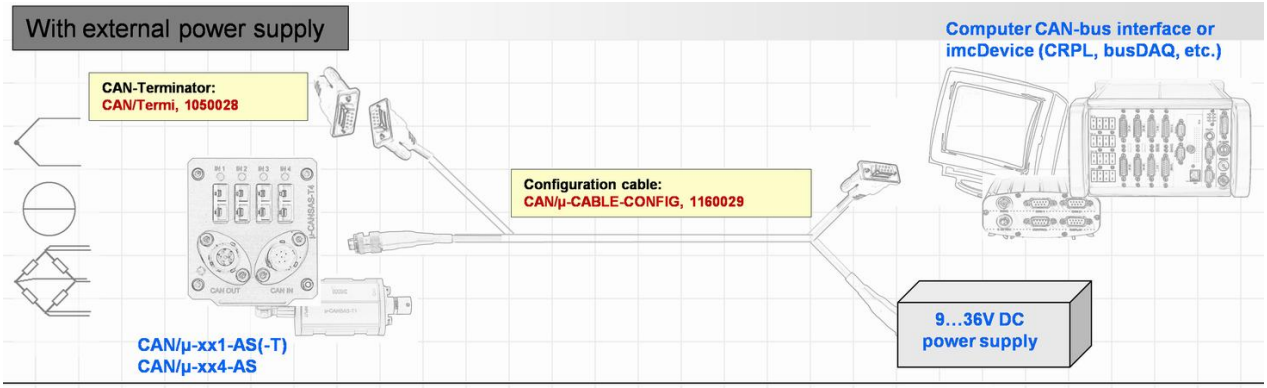
Other lines can be used for the purpose if necessary, for instance the synchronization line or even the power supply line.

Note when using Autosport plugs and cables, that there is a limit on the maximum current through the Autosport-plug. The current should not exceed approx. 5A. An accordingly high power supply voltage for the modules may need to be used.

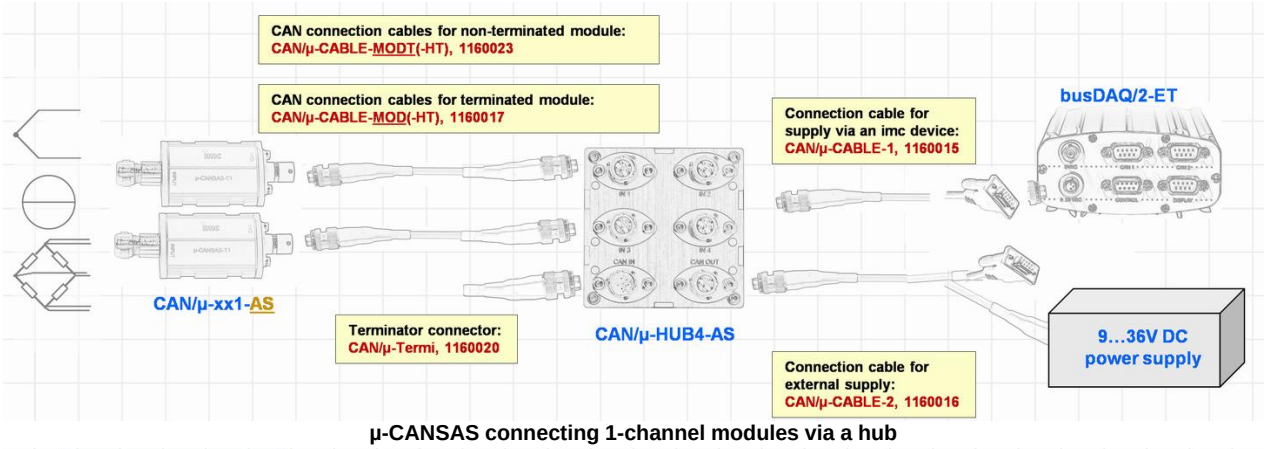
Check the cross-section of the cables.

8.1.3.2 Cables for µ-CANSAS

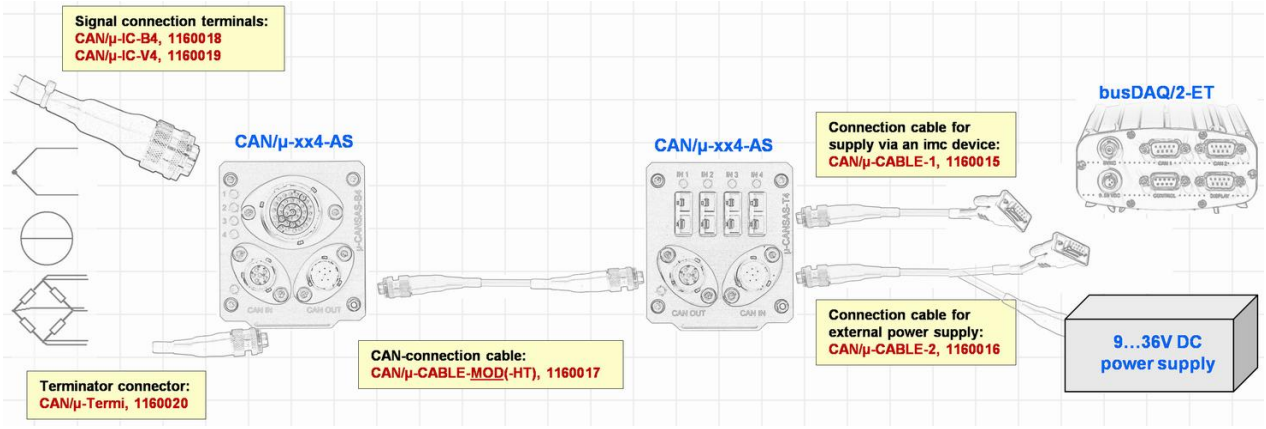
For connecting your µ-CANSAS modules, pre-configured cables are available. The connection schematics below are to help you select the necessary components. Like the µ-CANSAS modules, the µ-CANSAS cables are designed for use in extreme temperature conditions..


With external power supply
Computer CAN-bus interface or imcDevice (CRPL, busDAQ, etc.)
CAN-Terminator: CAN/Termi, 1050028
Configuration cable: CAN/µ-CABLE-CONFIG, 1160029
9…36V DC power supply
CAN/µ-xx1-AS(-T) CAN/µ-xx4-AS
When supplied from an imc device
CAN-Terminator: CAN/Termi, 1050028
Y-CAN cable: CAN/µ-Y-CABLE(-HT), 1160027

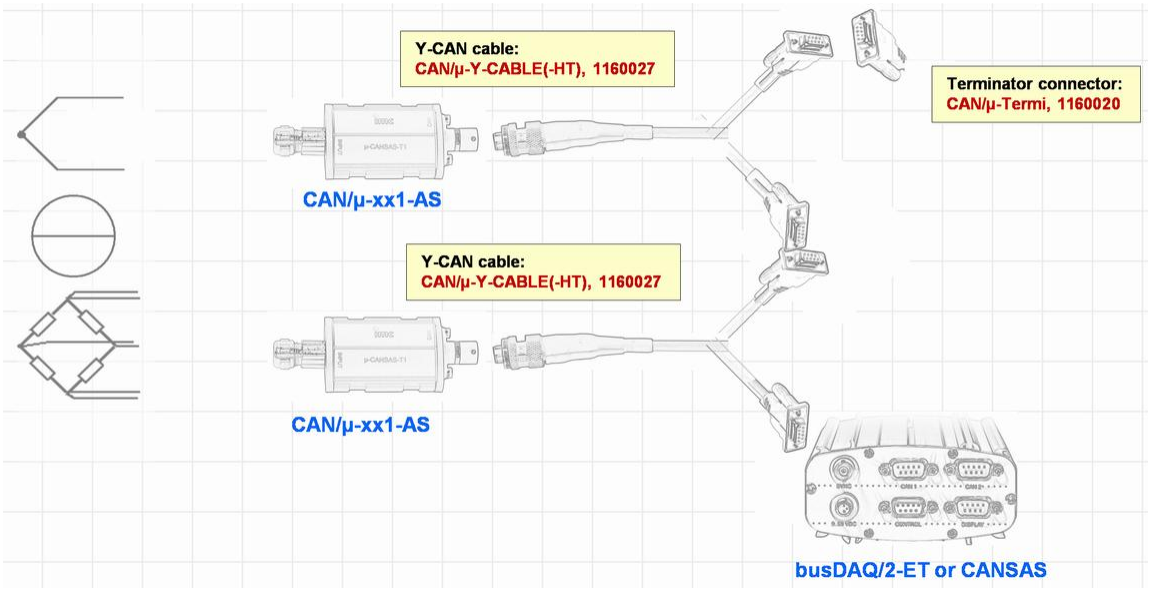
µ-CANSAS connecting a single module


CAN connection cables for non-terminated module: CAN/µ-CABLE-MODT(-HT), 1160023
CAN connection cables for terminated module: CAN/µ-CABLE-MOD(-HT), 1160017
Connection cable for supply via an imc device: CAN/µ-CABLE-1, 1160015
busDAQ/2-ET
CAN/µ-xx1-AS
Terminator connector: CAN/µ-Termi, 1160020
CAN/µ-HUB4-AS
9…36V DC power supply
Connection cable for external supply: CAN/µ-CABLE-2, 1160016

µ-CANSAS connecting 1-channel modules via a hub


Signal connection terminals: CAN/µ-IC-B4, 1160018 CAN/µ-IC-V4, 1160019
busDAQ/2-ET
CAN/µ-xx4-AS
CAN/µ-xx4-AS
Connection cable for supply via an imc device: CAN/µ-CABLE-1, 1160015
Connection cable for external power supply: CAN/µ-CABLE-2, 1160016
9…36V DC power supply
CAN-connection cable: CAN/µ-CABLE-MOD(-HT), 1160017
Terminator connector: CAN/µ-Termi, 1160020

µ-CANSAS connecting 4-channel modules in series



µ-CANSAS connecting 1-channel modules in series

Order code: CAN/µ-CABLE-1 Art. # M.1160015
Type 1 CAN connection cable: From 6-pin female AS608-35SA on device side to 9-pin DSUB-socket; shielded, 1,5 m. Temperature range: -15 °C … 60 °C. For direct connection of µ-CANSAS-xx-AS(T) and µ-HUB4-AS (µCANSAS connected via male CAN-connector, if connected at CAN IN socket [right side]) to the imc CAN-interface, if the module is supplied via the CAN-Bus.

Order code: CAN/µ-CABLE-2 Art. # M. 1160016
Type 2 CAN connection cable: From 6-pin female AS608-35SA on device side to 9-pin DSUB-socket and 4-pin Phoenix socket; shielded, 1,5 m. Temperature range: -15 °C … 60 °C. For direct connection of µ-CANSAS-xx-AS(T) and µ-HUB4-AS (µCANSAS connected via male CAN-connector, if connected at CAN IN socket [right side]) to the imc CAN-interface and an external power supply.

Order code: CAN/µ-CABLE-MOD Art. # M. 1160017
CAN connection cable, shielded, 1,5 m, 6-pin female AS608-35SA to 6-pin male AS608-35PA. Temperature range: -15 °C … 60 °C. For connection of a µ-CANSAS-x1-AST or µ-CANSAS-x4-AS with a µHUB4-AS, or of a µ-HUB4-AS together with a µ-CANSAS-x4-AS.

Order code: CAN/µ-IC-B4 Art. # M. 1160018
Signal connector for µ-CANSAS-B4-AS, 37-pin AS614-35PN

Order code: CAN/µ-IC-V4 Art. # M. 1160019
Signal connector for µ-CANSAS-V4-AS, 22-pin AS612-35PN

Order code: CAN/µ-TERMI Art. # M. 1160020
CAN-Bus terminator connector, 6-pin male AS608-35PN, internally terminated for connecting the CAN-Bus at the female CAN terminals of µ-CANSAS-V4-AS, µ-CANSAS-B4-AS, µ-CANSAS-T4-AS, µ-HUB4-AS (if connected at CAN OUT socket [left side]).

Order code: CAN/µ-CAN-F-CON Art. # M. 1160021
Connector with cable socket; 6-pin female AS608-35SA for the CAN-terminal of µ-CANSAS-x1-AS(T) and for the male CAN-connection of µ-CANSAS-x4-AS and µ-HUB4-AS (if connected at CAN IN socket [right side])

Order code: CAN/µ-CAN-M-CON Art. # M. 1160022
Connector with cable socket; 6-pin male AS608-35PA for the female CAN-terminal of µ-CANSAS-x4-AS, µHUB4-AS (if connected at CAN OUT [left side]) and for the four IN terminals of µ-HUB4-AS.

Order code: CAN/µ-CABLE-MODT Art. # M. 1160023
CAN connector cable, shielded, 1,5 m, 6-pin female AS608-35SA to 6-pin male AS608-35PA, with built-in terminator resistor on module side. Temperature range: -15 °C … 60 °C. For connection of a µCANSAS-

x1-AS with a µ-HUB4-AS

Order code: CAN/µ-CABLE-1-HT Art. # M. 1160024
Type 1 CAN connection cable: From 6-pin female AS608-35SA on device side to 9-pin DSUB-socket; shielded, 1,5 m. Temperature range: -40 °C … 120 °C. For direct connection of µ-CANSAS-x1-AST, µ-CANSAS-x4-AS(T) and µ-HUB4-AS (µ-CANSAS connected via male CAN-terminal, if connected at CAN IN socket [right side]) to the imc CAN-interface, if the module is supplied via the CAN-Bus.

Order code: CAN/µ-CABLE-MODT-HT Art. # M. 1160025
CAN connection cable, shielded, 1,5 m, 6-pin female AS608-35SA to 6-pin male AS608-35PA, with built-in terminator resistor on the module side. Temperature range: -40 °C … 120 °C. For connecting a µ-CANSAS-x1-AS with a µ-HUB4-AS.

Order code: CAN/µ-CABLE-MOD-HT Art. # M. 1160026
CAN connection cable, shielded, 1,5 m, 6-pin female AS608-35SA to 6-pin male AS608-35PA. Temperature range: -40 °C … 120 °C. For connecting a µ-CANSAS-x1-AST or µ-CANSAS-x4-AS with a µ-HUB4-AS, or a µ-HUB4-AS together with a µ-CANSAS-x4-AS.

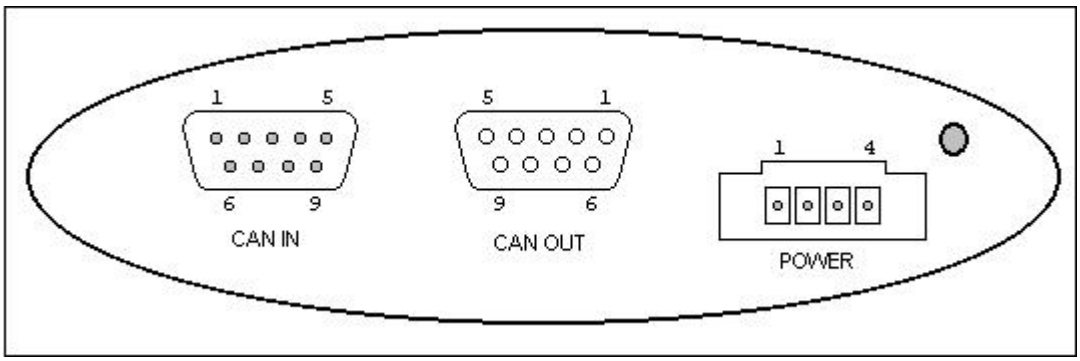
Order code: CAN/µ-Y-CABLE Art. # M. 1160027
CAN-Bus Y-cable; 6-pin female AS608-35SA on device side to 9-pin DSUB-socket and 9-pin DSUB-plug, shielded. Temperature range: -40 °C … 120 °C. For connecting multiple µ-CANSAS-x1-AS(T) units together or connection to the imc CAN-interface, if the module is supplied via the CAN-Bus. Due to the 0,14 mm² wire cross-section, only partially suitable for power supply via CAN-Bus.

Order code: CAN/µ-Y-CABLE-HT Art. # M. 1160028
CAN-Bus Y-cable, 6-pin female AS608-35SA on device side to 9-pin DSUB-socket and 9-pin DSUB-plug, shielded. Temperature range: -15 °C … 60 °C. For connection of multiple µ-CANSAS-x1-AS(T) units together or connection to the imc CAN-Interface if the module is supplied via the CAN-Bus. Due to the 0,14 mm² wire cross-section, only partially suitable for power supply via CAN-Bus.

Order code: CAN/µ-CABLE-CONFIG Art. # M. 1160029
Configuration cable for µ-CANSAS-xx-AS(T), 6-pin female AS608-35SA on device side to 9-pin DSUB-socket, 9-pin DSUB-plug and 4-pin Phoenix socket, shielded. Temperature range: -15 °C … 60 °C. Connection to µCANSAS via the male CAN-terminal (if connected at CAN IN [right side]); power supply via 4-pin Phoenix socket. Connection to imc CAN-interface via either the DSUB-socket or DSUB-plug. Due to the 0,14 mm² wire cross-section, only partially suitable for power supply via CAN-Bus.

8.2 Power Supply

8.2.1 Standard modules power supply



There are two possibilities for supplying CANSAS-modules with power:

- via the green Phoenix-jack labeled "POWER", or
- via the CAN-bus (+SUPPLY / -SUPPLY).

Supplying power via the CAN-bus-connectors has the advantage that it can be conducted further down the CAN-bus through the module and thus drive a cascade of modules as the sole supply.

Phoenix - socket

pin number (front view)	name	comments	
1 (left)	-SUPPLY	0V	
2	-SUPPLY	0V	
3	+SUPPLY	+10 V...+50 VDC	
4 (right)	+SUPPLY	+10 V...+50 VDC	

*for all types build from 2010. Before 9 V to 32 V. Exception: BRIDGE2 is build with 9 V to 32 V supply. (See identification plate of the module also.)

Note

- Note that the cumulative current for all connected devices flows through the CAN-bus power supply lines. Since D-SUB plugs are nominally designed to take 1 A rated current per pin, a maximum of three CANSAS modules should be supplied via the CAN-bus connection (with 12 V supply voltage and approx. 4W consumption per module, 1 A cumulatively flows in the 3 modules). If commercially available 9pin DSUB-cables are used, which tend to have high Ohm-counts, voltage loss in the lines must be taken into consideration (the input voltage measured at the module must not be less than 9 V!). To avoid that problem, choose a higher voltage, e.g. 24 V.
- The connectors at the Phoenix-terminal and those for the CAN-bus are not connected internally but are separated from each other by diodes. Therefore, make sure that the CANSAS module is supplied with power via only one of the two possible ways!
- Note when arranging the power supply that the starting current is greater than the long-term current. Also observe the remarks on CAN-bus wiring above.
- The imc CAN-bus connectors made for µ-MUSYCS do not meet CANSAS-module specs, but can under certain circumstances be modified by imc to do so. Please contact our customer support if interested.

8.2.2 CANSAS SL power supply

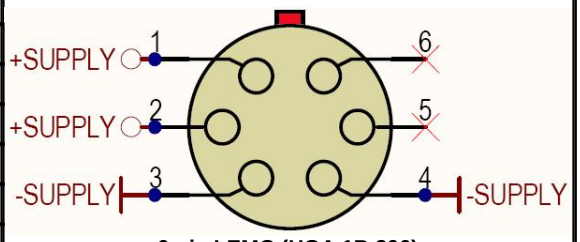
There are two possibilities for supplying CANSAS-modules with power:

- via the 6-pin LEMO socket labeled "POWER", or
- via the CAN-bus (+SUPPLY / -SUPPLY).

Supplying power via the CAN-bus-connectors has the advantage that it can be conducted further down the CAN-bus through the module and thus drive a cascade of modules as the sole supply.

LEMO - socket

Pin LEMO (front view)	Name	Remark	color of wire
1 (left)	+SUPPLY	+10 V...+50VDC	red
2	+SUPPLY	+10 V...+50VDC	
3	-SUPPLY	0 V	black
4 (right)	-SUPPLY	0 V	
5	---	n.c.	
6	---	n.c.	



6-pin LEMO (HGA.1B.306)

Note

- Note that the cumulative current for all connected devices flows through the CAN-bus power supply lines. Since LEMO plugs are nominally designed to take 2A rated current per pin, a maximum of 12 CANSAS modules should be supplied via the CAN-bus connection (with 12 V supply voltage and approx. 4W consumption per module, 1A cumulatively flows in the 3 modules). If commercially available 10-pin LEMO-cables are used, which tend to have high Ohm-counts, voltage loss in the lines must be taken into consideration (the input voltage measured at the module must not be less than 10 V!). To avoid that problem, choose a higher voltage, e.g. 24 V.
- The connectors at the 6-pin LEMO socket and those for the CAN-bus are not connected internally but are separated from each other by diodes. Therefore, make sure that the CANSAS module is supplied with power via only one of the two possible ways!
- The DC-supply inputs ***on the device itself (LEMO-socket***) are ***galvanically isolated***, i.e. isolated from the housing! If a *CANSAS-SL* is powered by an isolated DC-voltage source (e.g., battery), use the shielding of the supply plug or CAN-Bus plug to ground the device.
- Also, all ***signal leads*** to *CANSAS-SL* must be shielded and the shielding grounded (electric contact between the shielding and the ***plug housing***).
- Note when arranging the power supply that the starting current is greater than the long-term current. Also observe the remarks on CAN-bus wiring above.
- The imc CAN-bus connectors made for µ-MUSYCS do not meet CANSAS-module specs, but can under certain circumstances be modified by imc to do so. Please contact our customer support if interested.

8.2.3 µ-CANSAS power supply

The µ-CANSAS modules are supplied via the CAN-Bus terminals +SUPPLY and –SUPPLY (see image in previous section for pin configuration). The permitted supply voltage range for the µ-CANSAS modules is 9 V...50 V DC.

☞ **Notes**

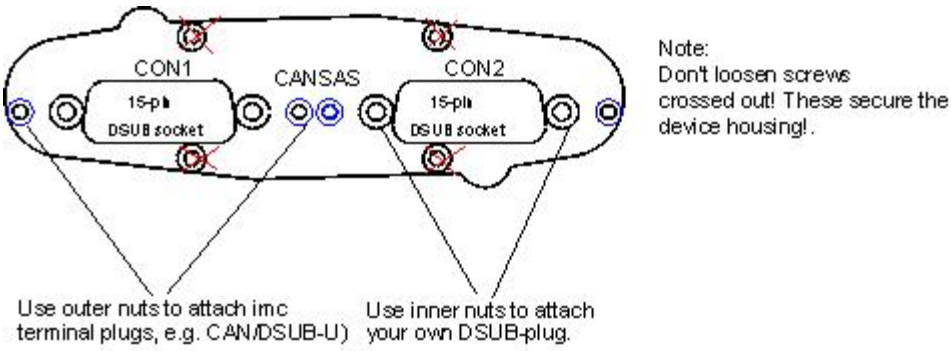
- Be aware that the total current of all connected devices flows through the CAN-Bus supply lines. When a commercially available 6-pin cable is used, the voltage drop along the supply lines must additionally be taken into consideration, since they have relatively high resistance (the input voltage, measured at the module, may not be less than 9 Volts!). So, to avoid problems select a higher power supply voltage, e.g. 24 V.
- When dimensioning the current supply, note that the power-on current is higher than the long-term current. Also make note of the information presented above on the CAN-Bus' wiring.
- imc µ-Musycs' CAN-Bus terminals are not rated for the supply of CANSAS modules, but under certain circumstances they can be modified at imc for this purpose. If interested, please contact our Customer Support.

8.3 Pin configuration of the connectors

General note
Channels whose signal is to be measured must always be connected to a sensor or at least shorted at the input. Open inputs can cause the amplifier to be overmodulated, which can lead to interference or measurement uncertainty on the other channels. In such cases, the values of the technical specifications may not be reached.

8.3.1 Standard modules with DSUB15

The illustration below shows the view of the CANSAS module from the inputs' side:



All measurement inputs are routed to the DSUB-15 sockets CON1 and CON2. The inputs can be connected either via the various connectors which imc provides and which are each customized for a different signal type, or via standard DSUB-15 (male) connectors.

The specially designed connectors from imc (e.g. CAN/DSUB-U), included in the product package, allow very convenient and easy operation. The connector housing contains screw terminals made for attaching the measurement lines.

For an overview of all available connectors see here 429.

8.3.1.1 Modules with CAN-terminals

ISO8, C12, DO16, DO8R, DO16R, DI16, DAC8, INC4

CAN/DSUB		-U4, -U4D, -I4,-T4	-U6, -U6D, -I6,-T6	-PT100	-DO16	-STD (RELAIS)	- DI	-DAC	-INC
Signal		voltage, voltage-divider, current, thermocouples		RTD/ PT100	TTL-Output	switch	TTL-Input	±10 V Output	TTL-Input
DSUB-15 Pin	**Terminal number**	**ISO8**	**C12**	**ISO8, C12**	**DO16**	**DO8R/ DO16R**	**DI16**	**DAC8**	**INC4**
9	1	+IN1	+IN 1	+IN1	BIT1	IN 1	+IN 1	NC	+IN 1X
2	2	-IN1	-IN 1	-IN1	BIT2	IN 2	+IN 2	OUT 1	-IN 1X
10	3	+IN2	+IN 2	+IN2	BIT3	IN 3	-IN 1/2	GND	+IN 1Y
3	4	-IN2	-IN 2	-IN2	BIT4	IN 4	+IN 3	NC	-IN 1Y
11	5	+IN3	+IN 3	+IN3	BIT5	ON 1	+IN 4	OUT 2	+IN 2X
4	6	-IN3	-IN 3	-IN3	BIT6	ON 2	-IN 3/4	GND	-IN 2X
12	7	+IN4	+IN 4	+IN4	BIT7	ON 3	+IN 5	NC	+IN 2Y
5	8	-IN4	-IN 4	-IN4	BIT8	ON 4	+IN 6	OUT 3	-IN 2Y
13	9	VCC	+IN 5	+I1		OFF 1	-IN 5/6	GND	+INDEX*
6	10	GND	-IN 5	-I1		OFF 2	+IN 7	NC	-INDEX
14	11	+DOUT1	+IN 6	+I4	HCOM	OFF 3	+IN 8	OUT 4	+5V
7	12	-DOUT1	-IN 6	-I4	LCOM	OFF 4	-IN 7/8	GND	GND
	13			+I2					
15	14			-I2	LCOM	NC	NC1	NC	NC
8	17			+I3	OPDRN	NC	NC	NC	NC
	18			-I3					
1, Gehäuse	15,16	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS

*Index at CON1 only

**** For CAN/DSUB-STD(RELAIS), ACC/DSUB-REL4 could be used as replacement. Note that OFF and ON are swapped.*

8.3.1.2 Modules with ACC-terminals

SCI8, SCI16, SC16, C8, UNI8, BRIDGE2

ACC/ Signal	DSUB	-U4, -I4	-T4	-U4D	-UNI2, B2	-B1	-I2
		Voltage, Current	Thermocouple, RTD, Voltage	V.-Divider	Universal	Bridge	Current
DSUB-15 Pin	**Terminal number**	**SCI8, SCI16, SC16, C8, CI8**	**SCI8, SCI16, SC16, C8, CI8**	**SC16**	**UNI8, DCB8**	**BRIDGE2**	**UNI8,**
9	1	Res.	+I1		+VB1	+SENSE1	+Supply1
2	2	+IN1	+IN1	+IN1	+IN1	+VB1	+IN1
10	3	-IN1	-IN1	-IN1	-IN1	+IN1	-IN1
3	4	+Supply	+I2	(+Supply)	-VB1	-IN1	-Supply1
11	5	+IN2	+IN2	+IN2	I1_1/4B1	-VB1	+SENSE1
4	6	-IN2	-IN2	-IN2	SENSE1		-SENSE1
12	7	-Supply	+I3	(-Supply)	+VB2		+Supply2
5	8	+IN3	+IN3	+IN3	+IN2		+IN2
13	9	-IN3	-IN3	-IN3	-IN2		-IN2
6	10	GND	-I4	(GND)	-VB2		-Supply2
14	11	+IN4	+IN4	+IN4	I2_1/4B2	+5V	+SENSE2
7	12	-IN4	-IN4	-IN4	SENSE2	GND	-SENSE2
15	14	GND	-I2		GND	HB	GND
8	17	(+5V)*	-I3		+5V**	CAL	+5V**
	13		-I1				
	18		+I4				
Chassis	15,16	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS

** not C8, **not for CANSAS*

ENC4, DI16, DO16, DO8R, DO16R, DAC8, PWM8

ACC/DSUB		-ENC4	-ENC4-IU	-DO8	-DAC4	-PWM4	-REL4***	-DI2-8
Signal		Incremental encoder	-IU converter	8 Bit block isolated	±10 V Output	TTL Pulse	4 relay outputs	8 digital inputs
DSUB-15 Pin	**Terminal number**	**INC4**	**INC4**	**DO16**	**DAC8**	**PWM8**	**DO8R / DO16R**	**DI16**
9	1	+INA	+INA	BIT1		$PWM\_1_{Open\ Drain}$	IN1	+IN1
2	2	-INA	-INA	BIT2	DAC1	$PWM\_2_{Open\ Drain}$	IN2	+IN2
10	3	+INB	+INB	BIT3	AGND	PWM_1_{TTL}	IN3	-IN1/2
3	4	-INB	-INB	BIT4		PWM_2_{TTL}	IN4	+IN3
11	5	+INC	+INC	BIT5	DAC2	$PWM\_3_{Open\ Drain}$	OFF1***	+IN4
4	6	-INC	-INC	BIT6	AGND	$PWM\_4_{Open\ Drain}$	OFF2	-IN3/4
12	7	+IND	+IND	BIT7		PWM_3_{TTL}	OFF3	+IN5
5	8	-IND	-IND	BIT8	DAC3	PWM_4_{TTL}	OFF4	+IN6
13	9	+INDEX*	+INDEX*		AGND	NC	ON1	-IN5/6
6	10	-INDEX	-INDEX			NC1	ON2	+IN7
14	11	+5V	+5V	HCOM	DAC4	VCC	ON3	+IN8
7	12	GND	GND	LCOM	AGND	GND	ON4	-IN7/8
15	14			LCOM		GND	(GND)	LEVEL
8	17			OPDRN**		NC		LCOM
	13							
	18							
Chassis	15,16	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS

* Index at CON1 only;

** OPDRN is reserved and is not to be connected.

****ACC/DSUB-REL4 should only be used as replacement for CAN/DSUB-STD (RELAIS). Note that OFF and ON are swapped.*

8.3.1.3 TEDS plugs (ACC/DSUB-TEDS) DSUB-15 sockets

measurement mode (labeled inside)	VOLTAGE	CURRENT	CURRENT	TH-COUPLE / RTD / VOLTAGE	UNIVERSAL	BRIDGE
compatible module type CRPL	SCI8, SC16, SCI16, CI8	SCI8, SC16, SCI16, CI8	UNI-8	SCI8, SC16, SCI16, CI8	UNI-8	UNI-8 DCB-8
name ACC/DSUB-	*TEDS-U4*	*TEDS-I4*	*TEDS-I2*	*TEDS-T4*	*TEDS-UNI2*	*TEDS-B2*
terminals		shunt internal in plug				
1	(RES.)	(RES.)	+SUPPLY1	+IREF	+VB1	+VB1
2	+IN1	+IN1	+IN1	+IN1	+IN1	+IN1
3	-IN1	-IN1	-IN1	-IN1	-IN1	-IN1
4	(+SUPPLY)	(+SUPPLY)	-SUPPLY1		-VB1	-VB1
5	+IN2	+IN2	+SENSE1	+IN2	I1_1/4B1	+SENSE1_1/4B1
6	-IN2	-IN2	-SENSE1	-IN2	-SENSE1	-SENSE1
7	(-SUPPLY)	(-SUPPLY)	+SUPPLY		+VB2	+VB2
8	+IN3	+IN3	+IN2	+IN3	+IN2	+IN2
9	-IN3	-IN3	-IN2	-IN3	-IN2	-IN2
10	GND	GND	-SUPPLY2	-IREF	-VB2	-VB2
11	+IN4	+IN4	+SENSE2	+IN4	I2_1/4B2	+SENSE2_1/4B2
12	-IN4	-IN4	-SENSE2	-IN4	-SENSE2	-SENSE2
14	TEDS2	TEDS2	(GND)	TEDS2	(GND)	GND
17	TEDS3	TEDS3	+5V**	TEDS3	+5V**	+5V**
13	TEDS1	TEDS1	TEDS1	TEDS1	TEDS1	TEDS1
18	TEDS4	TEDS4	TEDS2	TEDS4	TEDS2	TEDS2
15	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS	CHASSIS
16	TEDS_GND	TEDS_GND	TEDS_GND	TEDS_GND	TEDS_GND	TEDS_GND

***not for CANSAS*

8.3.1.4 Connector plugs Cross-Reference

module	measurement mode signal	order no.	price list	1350002 ACC/DSUB(-TEDS)-U4(-IP65)	ACC/DSUB-U2-BNC	ACC/DSUB(-TES)-B2(-IP65)	1350003 ACC/DSUB(-TEDS)-T4(-IP65)	1350004 ACC/DSUB(-TEDS)-I4(-IP65)	1350009 ACC/DSUB-TEDS-UNI2	1350010 ACC/DSUB-UD4	1350025 ACC/DSUB-ENC4	1350027 ACC/DSUB-DI2-8	1350028 ACC/DSUB-REL4	1350029 ACC/DSUB-DO8	1350030 ACC/DSUB-DAC4	1350031 ACC/DSUB-PWM4	1350035 ACC/DSUB-UNI2	1350037 ACC/DSUB-I2
CAN/BRIDGE2	Voltage, Bridge	1050038	CAN/DSUB-BR															
CAN/C8	Voltage	1050109	CAN/DSUB-C-8-U	x														
	Current	1050108	CAN/DSUB-C-8-I					x										
	Temperatur, Voltage	1050110	CAN/DSUB-C-8-T				x											
CAN/DAC8	Voltage	1050040	CAN/DSUB-DAC												x			
CAN/DI16	Voltage *	1050041	CAN/DSUB-DI									x						
CAN/DO16	Voltage	1050042	CAN/DSUB-DO16											x				
CAN/DO8R CAN/DO16R	Voltage	1050043	CAN/DSUB-STD (Relais)										x **					
CAN/DCB8	Voltage, Bridge		---		x													
CAN/INC4	Voltage	1050039	CAN/DSUB-INC								x							
CAN/PWM8	Voltage	1050122	CAN/DSUB-PWM													x		
CAN/SC16	Voltage with divider		---							x								
CAN/SCI8 CAN/SCI16 CAN/SC16 CAN/CI8	Voltage		---	x														
	Current		---					x										
	Temperatur, Voltage		---				x											
CAN/UNI8	Voltage, Bridge, Temp.	1050117	CAN/DSUB-UNI8 -UNI		x	x											x	
	Voltage,Bridge Temp. für TEDS	---	---						x									
	Current	1050118	CAN/DSUB-UNI8-I															x

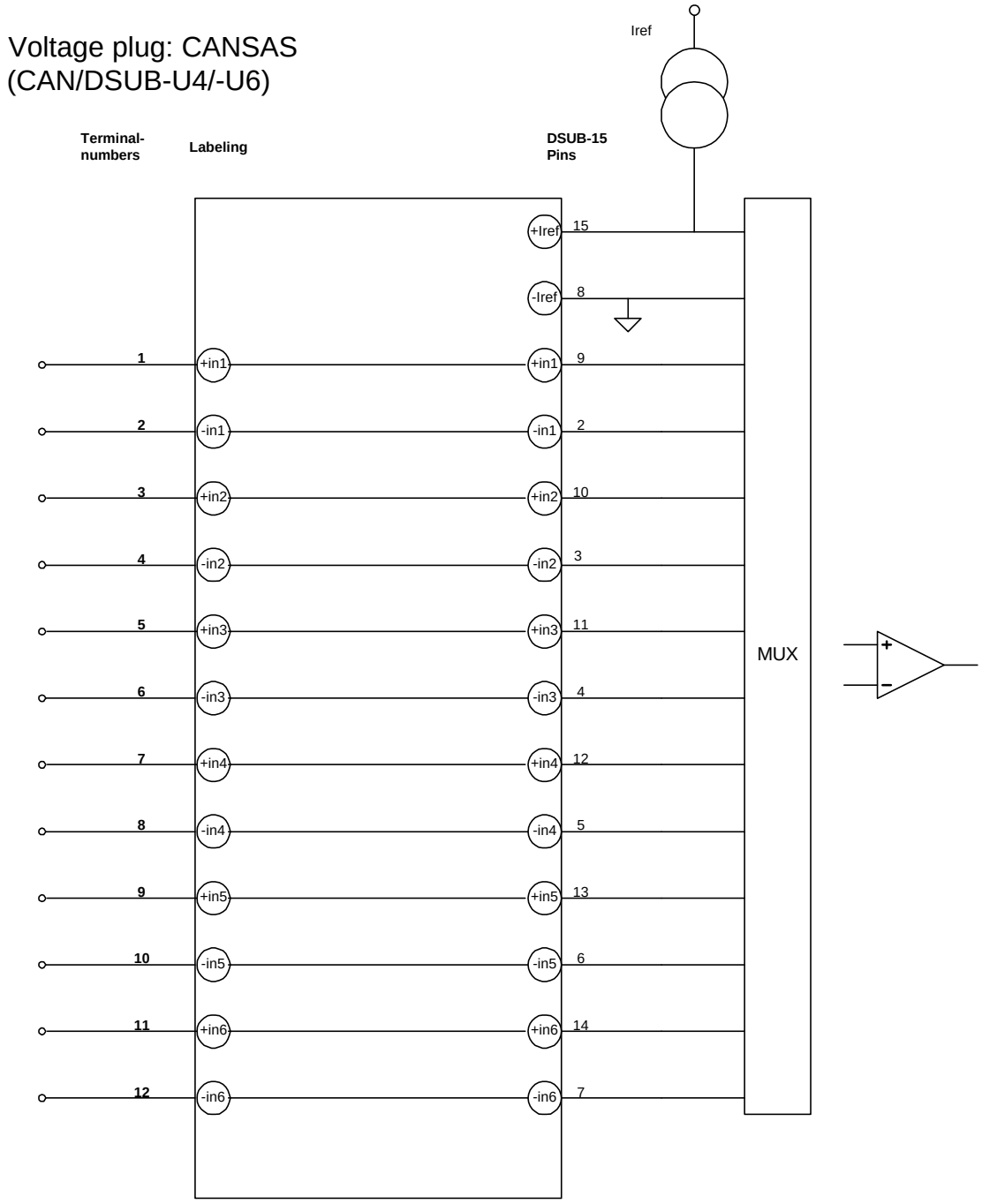
* 2-bit block isolated low impedance

** ON and OFF swapped, CAN/DSUB-STD(RELAIS) is the recommended and delivered plug

8.3.1.5 imc plugs

8.3.1.5.1 imc voltage plug

CAN/DSUB-U4



The plug CAN/DSUB-U6/U4 serves to connect six voltage signals to CANSAS-C12 and four voltage signals to CANSAS-ISO8.

Divider-plug CAN/DSUB-U6D / U4D

Note

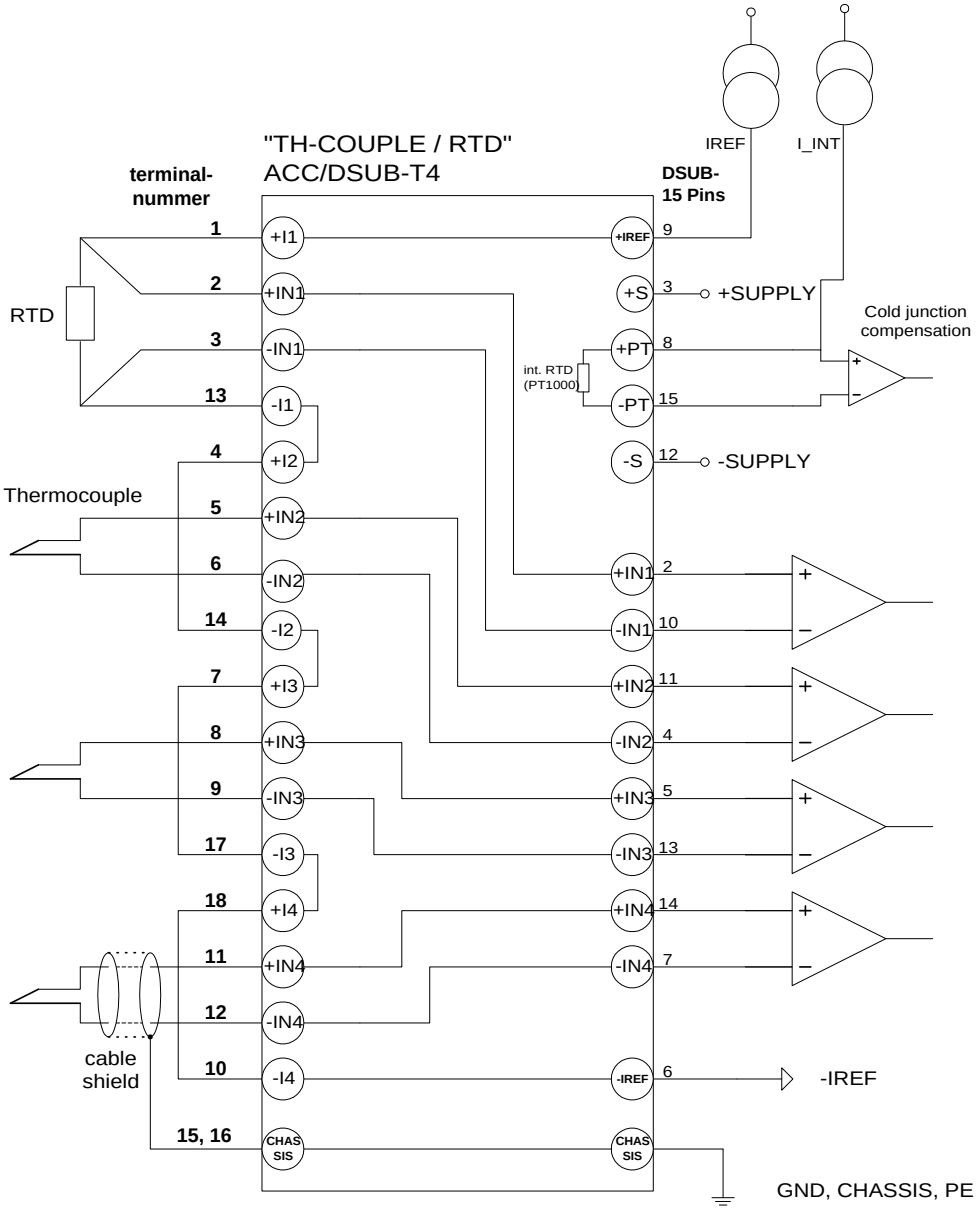
- The maximum signal voltage is 60V!
- Note that the resistance dividers are not symmetrical!
- The divider plug CAN/DSUB-U6D serves to connect six voltage signals to CANSAS-C12.
- The accuracy ratings only apply to devices correctly configured and connected. Special are must be taken that no inputs used may be open (unconnected), otherwise overshoot may occur at inputs, thus affecting other channels and resulting in increased measurement error.

8.3.1.5.2 imc Thermo-plug

ACC/DSUB-T4

The patented imc thermo-plug comes with a terminal strip and a built-in temperature sensor (PT1000) which provides cold junction compensation inside of the DSUB-15 connector. By this means, any thermocouple types can be connected at the differential inputs (+*IN* and -*IN*):

The temperature sensor measures the contact's own temperature and compensates its parasitic thermal voltage. In order to avoid additional (uncontrolled) thermal voltages, compensation lines of the same material as the thermocouple should be used, or the thermocouple connected directly.


"TH-COUPLE / RTD"
ACC/DSUB-T4
terminal-
nummer
DSUB-
15 Pins
IREF
I_INT
RTD
Thermocouple
cable
shield
int. RTD
(PT1000)
Cold junction
compensation
+SUPPLY
-SUPPLY
-IREF
GND, CHASSIS, PE
+I1
+IN1
-IN1
-I1
+I2
+IN2
-IN2
-I2
+I3
+IN3
-IN3
-I3
+I4
+IN4
-IN4
-I4
CHAS
SIS
+IREF
+S
+PT
-PT
-S
+IN1
-IN1
+IN2
-IN2
+IN3
-IN3
+IN4
-IN4
-IREF
CHAS
SIS
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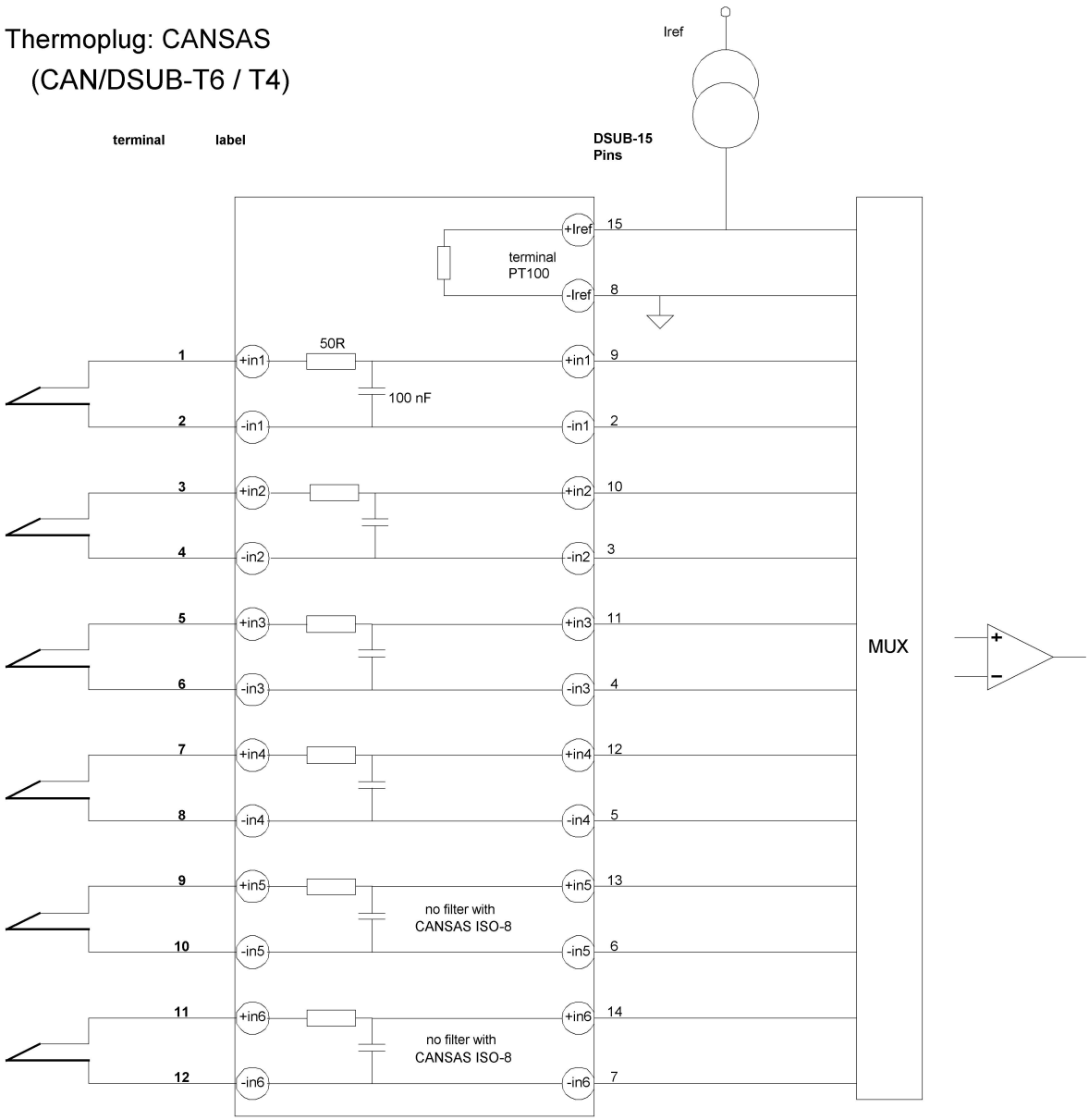
6

Thermoplugs for ISO8 and C12

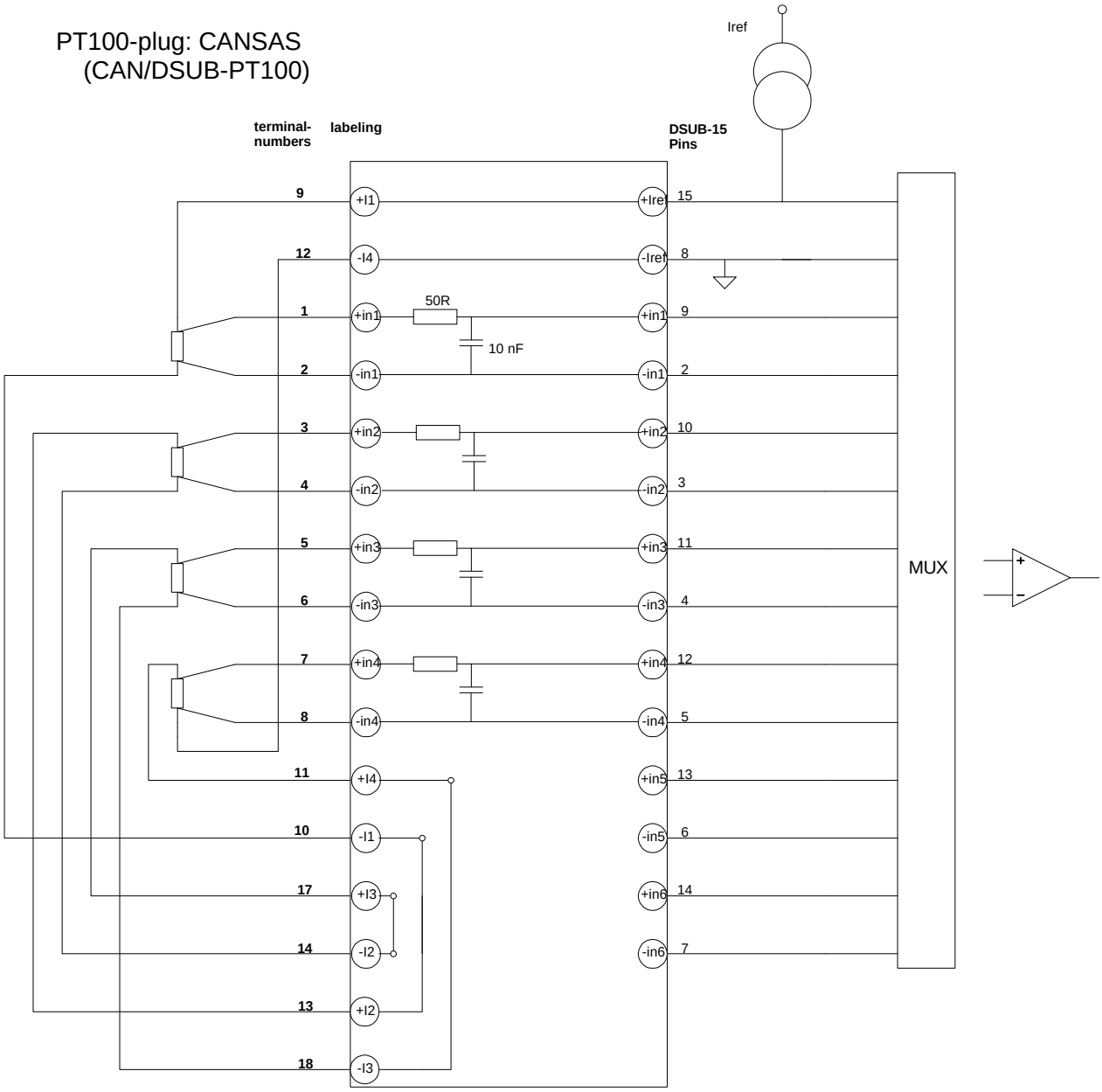


☞ ...**Note**

- The thermoplug CAN/DSUB-T6 serves to connect six thermocouples to CANSAS-C12.
- When connecting the thermoplug to CANSAS, you must wait until the signal contact's (internal PT100) low-pass-filtered temperature signal transient has subsided and the thermoplug's temperature has adjusted itself to that of the module. The time delay should be at least 5 seconds but may be greater if the temperature discrepancy is large (up to several minutes is possible).
- The signal contact's temperature inside the plug is measured. In order to achieve the precision specified, the plug must always be used while screwed shut!

PT100-plugs for ISO8 and C12

PT100-plug: CANSAS
(CAN/DSUB-PT100)



Note

- Four PT100-thermocouples can be connected to the CAN/DSUB-PT100 screw terminals in four-wire configuration. The necessary feed-current is provided by the CANSAS module.
- To close the current loop, any non-connected PT100 units must be replaced with wire bridges:
- No PT100 at Terminals 1+2 → bridge Terminals 9+10.
- No PT100 at Terminals 3+4 → bridge Terminals 13+14.
- No PT100 at Terminals 5+6 → bridge Terminals 17+18.
- No PT100 at Terminals 7+8 → bridge Terminals 11+12.

8.3.2 Pin configuration DSUB-9 connectors

8.3.2.1 CANSAS-K-INC4

DSUB-9 Pin	CON1	CON2	CON3	CON4
1	+IN1Y	+IN2Y	+IN3Y	+IN4Y
6	-IN1X	-IN2X	-IN3X	-N4X
2	+IN1Y	+IN2Y	+IN3Y	+IN4Y
7	-IN1Y	-IN2Y	-IN3Y	-IN4Y
3	+INDEX[2]	+INDEX	+INDEX	+INDEX
8	-INDEX	-INDEX	-INDEX	-INDEX
4	NC	NC	NC	NC
9	GND	GND	GND	GND
5	+5V	+5V	+5V	+5V

[2]*The incremental counter inputs have a common index track, which is connected in parallel to the other inputs in each DSUB.*

8.3.3 Modules with ITT VEAM terminals

CANSAS-UNI8, -L-CI8-V(-SUPPLY), -L-INC4-V(-SUPPLY)

Round plugs ITT-VEAM (MIL-C-26482)

ITT VEAM PIN	-UNI8	-L-CI8-V	-L-CI8-V-SUPPLY	-L-INC4-V	-L-INC4-V- SUPPLY
A	+IN	+IN	+IN	+IN X	+IN X
B	-IN	-IN	I_PT (RTD current source)	-IN X	-IN X
C	+SUPPLY	-	+SUPPLY	+IN Y	+SUPPLY
D	-SUPPLY	GND	-IN	-IN Y	-SUPPLY
E	TEDS	TEDS	TEDS		+IN Y
F	SENSE/ RTD current source	I_PT (RTD current source)	-SUPPLY		CON1 & 3 +INDEX CON2 & 4 -INDEX*
G	quarter bridge completion, Sense-lead for RTD 3-wire connector	+I	+I	CHASSIS	-IN Y

**The index terminal is split between two jacks in CANSAS L-INC4-V. +INDEX is at jack 1: Pin F, -INDEX on jack 2: Pin F. Alternatively, the INDEX track can be connected via jack 2 and 4:Pin4, since these pins are connected internally.*

CANSAS -L-DO8R-V, -L-DI16-V, -L-DAC8-V, -L-PWM8-V

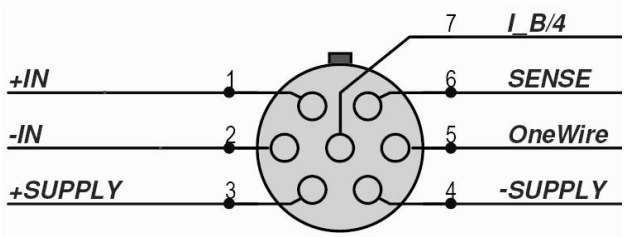
ITT VEAM PIN	-L-DO8R-V	-L-DI16-V	-L-DAC8-V	L-PWM8-V
A	IN	+IN		PWM Open Drain
B	ON	-IN		
C	OFF		OUT	Vcc
D			GND	GND
E				
F				PWM TTL
G	CHASSIS	CHASSIS	CHASSIS	CHASSIS

8.3.4 CANSAS-SL with LEMO terminals

The CANSAS modules of the housing model SL which are equipped with LEMO connectors have certain limitations regarding measurement possibilities. The exact limitations are stated in the general technical specs of the respective module in the chapter General technical specs 380. With these modules, a separate LEMO connector is available for each channel.

8.3.4.1 DCB8, UNI8 LEMO

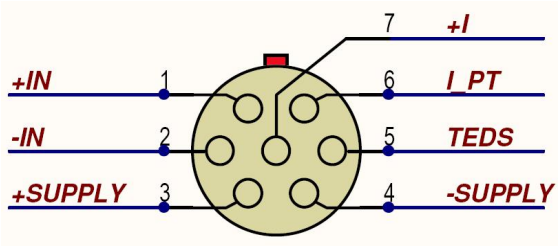
Pin configuration of the LEMO terminals for CANSAS-DCB8, -UNI8



LEMO PIN	-DCB8	-UNI8
1	+IN	+IN
2	-IN	-IN
3	+SUPPLY	+SUPPLY
4	-SUPPLY (GND)	-SUPPLY (GND)
5	TEDS (OneWire)	TEDS (OneWire)
6	SENSE	SENSE / RTD current source
7	quarter bridge completion	quarter bridge completion / Sense for PT100 3-wire configuration

8.3.4.2 C8, CI8, SCI8, SCI16, SC16 LEMO

Pin configuration of the LEMO terminals for CANSAS-C8, -CI8, -SCI8, -SCI16, -SC16



LEMO PIN	-C8	-CI8	-SCI8	-SCI16	-SC16
1	+IN	+IN	+IN	+IN	+IN
2	-IN	-IN	-IN	-IN	-IN
3	+SUPPLY	+SUPPLY	+SUPPLY	+SUPPLY	+SUPPLY
4	-SUPPLY (GND)	-SUPPLY (GND)	-SUPPLY (GND)	-SUPPLY (GND)	-SUPPLY (GND)
5	n.c.	TEDS (OneWire)	TEDS (OneWire)	TEDS (OneWire)	TEDS (OneWire)
6	PT100 current source	PT100 current source	PT100 current source	PT100 current source	PT100 current source
7	positive measurement input for current measurement	positive measurement input for current measurement	positive measurement input for current measurement	positive measurement input for current measurement	positive measurement input for current measurement

8.3.4.3 INC4 LEMO

Pin configuration of the LEMO terminals for CANSAS-INC4

LEMO PIN	-INC4
1	+IN X
2	-IN X
3	+IN Y
4	-IN Y
5	
6	
7	CHASSIS

8.3.5 Modules with Phoenix terminal block

8.3.5.1 CANSAS-K-DI16, -L-DI16-Ph Phoenix strip terminal

Signal	left terminal block	right terminal block	Signal
1+	+IN 1	+IN 9	9+
1-	-IN 1	-IN 9	9-
2+	+IN 2	+IN 10	10+
2-	-IN 2	-IN 10	10-
3+	+IN 3	+IN 11	11+
3-	-IN 3	-IN 11	11-
4+	+IN 4	+IN 12	12+
4-	-IN 4	-IN 12	12-
5+	+IN 5	+IN 13	13+
5-	-IN 5	-IN 13	13-
6+	+IN 6	+IN 14	14+
6-	-IN 6	-IN 14	14-
7+	+IN 7	+IN 15	15+
7-	-IN 7	-IN 15	15-
8+	+IN 8	+IN 16	16+
8-	-IN 8	-IN 16	16-
LEVEL 1	NC	NC	LEVEL 1
DGND	NC	NC	DGND
CHASSIS	CHASSIS	CHASSIS	CHASSIS

8.3.5.2 CANSAS-L-DO16-Ph Phoenix strip terminal

Signal	left terminal block	right terminal block	Signal
1+	BIT 1	BIT 9	9+
1-	LCOM 1	LCOM 2	9-
2+	BIT 2	BIT 10	10+
2-	LCOM 1	LCOM 2	10-
3+	BIT 3	BIT 11	11+
3-	LCOM 1	LCOM 2	11-
4+	BIT 4	BIT 12	12+
4-	LCOM 1	LCOM 2	12-
5+	BIT 5	BIT 13	13+
5-	LCOM 1	LCOM 2	13-
6+	BIT 6	BIT 14	14+
6-	LCOM 1	LCOM 2	14-
7+	BIT 7	BIT 15	15+
7-	LCOM 1	LCOM 2	15-
8+	BIT 8	BIT 16	16+
8-	LCOM 1	LCOM 2	16-
OD 1	NC	NC	OD 2
GND 1	LCOM 1	LCOM 2	GND 2
5 V 1	HCOM1	HCOM2	5 V 2
GND 1	LCOM 1/CHASSIS	LCOM 2/CHASSIS	GND 2

8.3.5.3 CANSAS-L-DO8R-Ph Phoenix strip terminal

connection socket	1	2	3	4	5	6	7	8
IN	IN1	IN2	IN3	IN4	IN5	IN6	IN7	IN8
ON	ON1	ON2	ON3	ON4	ON5	ON6	ON7	ON8
OFF	OFF1	OFF2	OFF3	OFF4	OFF5	OFF6	OFF7	OFF8
CHASSIS	-	-	-	CHASSIS	-	-	-	CHASSIS

8.3.5.4 CANSAS-HCI8

Pin configuration of the Phoenix strip terminal for CANSAS-HCI8

Connection via PHOENIX spring-clasp terminals, 5 contacts/channel

pin configuration for each input IN1 to IN8

PIN	Signal
1	+ IN
2	- IN
3	+ I
4	+ PT
5	- PT

PHOENIX FFKDS 3,81

8.3.5.5 µ-CANSAS Phoenix strip terminal

Pin configuration of the Phoenix strip terminal for µ-CANSAS-V1-AS

Phoenix MPT0,5/8	Pin	Signal
8-pin Phoenix strip terminal 8-Pin Phoenix MPT0,5/8 Contact inserts with screw connections	8	+IN with divider (MR 2..60V)
	7	+IN without divider (MR 0,1..1V)
	6	-IN_COM
	5	reserved
	4	-SUPPLY
	3	+SUPPLY
	2	reserved
	1	reserved

Pin configuration of the Phoenix strip terminal for µ-CANSAS-B1-AS

Phoenix MPT0,5/8	Pin	Signal
8-pin Phoenix strip terminal 8-Pin Phoenix MPT0,5/8 Contact inserts with screw connections	8	reserved
	7	+IN
	6	-IN_COM
	5	HB
	4	-SUPPLY
	3	+SUPPLY
	2	-Sense
	1	+Sense

Pin configuration of the Phoenix strip terminal for µ-CANSAS-T1-AS

Phoenix MPT0,5/8	Pin	Signal
8-pin Phoenix strip terminal 8-Pin Phoenix MPT0,5/8 Contact inserts with screw connections	8	reserved
	7	+IN
	6	-IN_COM
	5	reserved
	4	reserved
	3	reserved
	2	reserved
	1	reserved

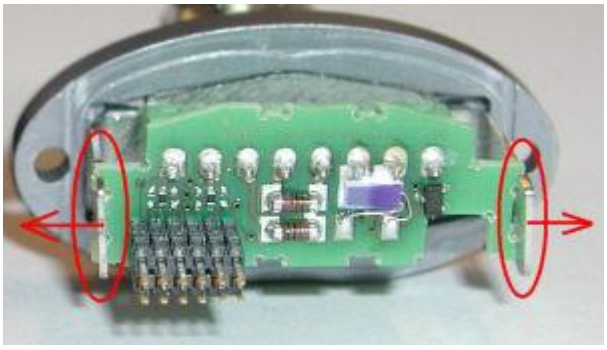
8.3.5.5.1 Connection instructions

Within a µ-CANSAS module there is a Phoenix strip terminal (model: MPT0.5/8) for connecting sig-nals. This strip terminal is located on a connector junction which can be detached from the front of the module. The cable grommet is a *UNI EMC* screwed cable gland of model *UNI ENTSTÖR DICHT* from the company Pflitsch. When threading the cable, please adhere to the manufacturer's instructions. The following section explains step-by-step how to access the connector junction and how to make the necessary connections.

Step 1: Unfasten the two Torx screws from the housing face.

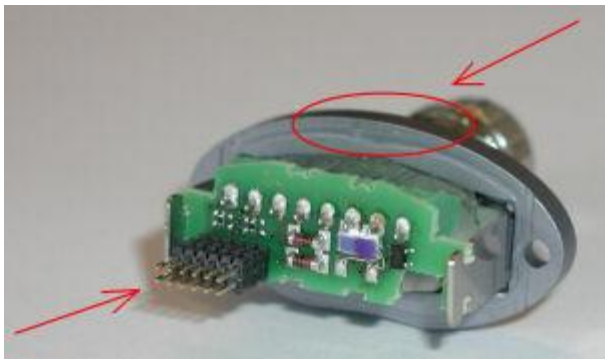
Step 2: Carefully pull the housing face out until the connections are exposed.

Step 3: Detach the connector junction with its Phoenix strip terminal from the housing face by gently bending the clamping brackets at the sides outward.

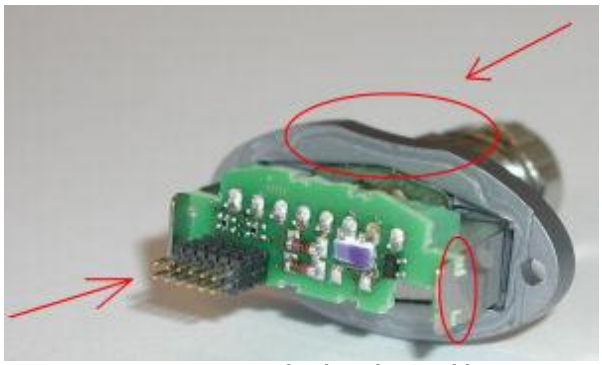


Step 4: Feed the cable through the gland in accordance with the manufacturer's instructions and con-nect the leads according to the pin configuration for connector pins 459.

Step 5: Re-attach the connector junction into its former position by means of the clamping brackets. Gently tug the cable back outwards through the gland in order to straighten out the individual leads, to prevent them from possibly becoming bent or stuck. When installing the connector junction, ensure that it is not positioned upside down. The recess in the profile of the housing face is an indication of whether the connector junction is installed correctly.



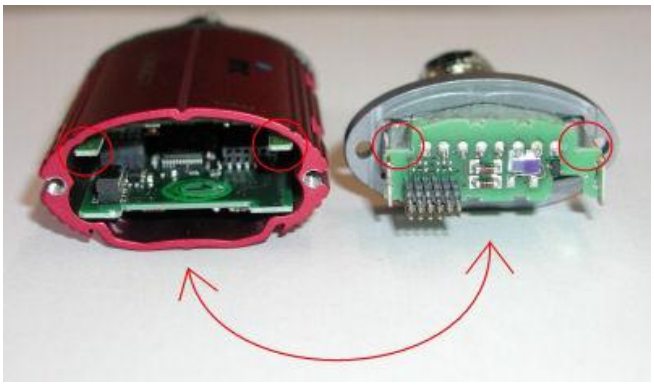
Correct connection junction position

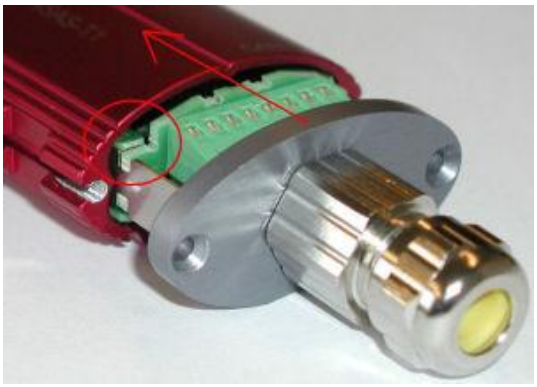


Incorrect connection junction position

Step 6: Check that the cable and leads are not under strain or tension and then close the cable gland, which is designed for cables of 4 – 6 mm in diameter. If the cable used is thinner, then its diameter in the section passing through the gland must be made correspondingly wider by means of heat-shrinkable tubing.

Step 7: Carefully insert the housing face into the housing. Make absolute certain that the housing and its face are attached together in the correct position. This can be ascertained on the basis of the grooves in the connector junction's plate which are shaped to accommodate the guide rails inside the housing (see photos below). Also, the correct position is distinguished by the recess in the profile of the housing face, which fits over one side of the housing.

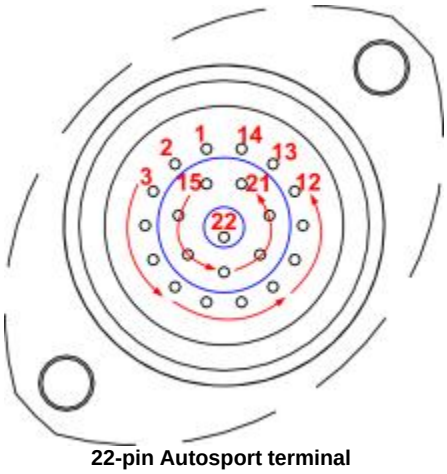




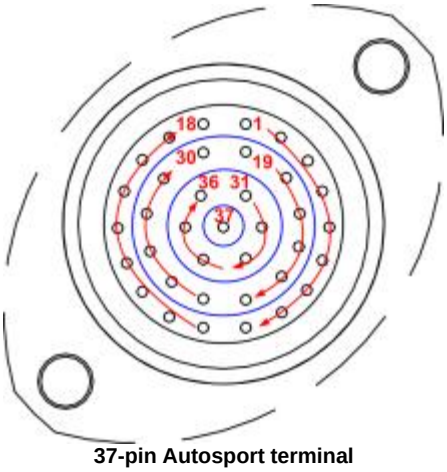
Step 8: Once the housing face is placed flush on the housing, the module can be closed tight with the Torx screws.

8.3.6 Modules with Autosport (AS) terminals

Pin configuration of the Autosport terminal type AS212-35SN for µ-CANSAS-V4-AS

AS212-35SN	Pin	Signal
 **22-pin Autosport terminal of the type AS212-35SN**	1	+IN_60V_CH1 (MB: 2..60V)
	2	+IN_1V_CH1 (MB: 0,1..1V)
	3	+SUPPLY_CH1
	4	+SUPPLY_CH2
	5	-SUPPLY_CH2
	6	+SUPPLY_CH3
	7	n.c.
	8	-SUPPLY_CH4
	9	+IN_60V_CH4 (MB: 2 .. 60V)
	10	+IN_1V_CH4 (MB: 0,1 .. 1V)
	11	+IN_60V_CH3 (MB: 2 .. 60V)
	12	+IN_1V_CH3 (MB: 0,1 .. 1V)
	13	+IN_60V_CH2 (MB: 2 .. 60V)
	14	+IN_1V_CH2 (MB: 0,1 .. 1V)
	15	-IN_COM_CH1
	16	-SUPPLY_CH1
	17	-SUPPLY_CH3
	18	+SUPPLY_CH4
	19	-IN_COM_CH4
	20	-IN_COM_CH3
	21	-IN_COM_CH2
	22	n.c.

Pin configuration of the Autosport terminal type AS214-35SN for µ-CANSAS-B4-AS

AS214-35SN	Pin	Signal
 **37-pin Autosport terminal of the type AS214-35SN**	1	+Sense_CH4
	2	+SUPPLY_CH4
	3	HB_CH4
	4	-IN_COM_CH4
	5	HB_CH3
	6	-IN_COM_CH3
	7	n.c.
	8	n.c.
	9	HB_CH2
	10	-IN_COM_CH2
	11	-IN_COM_CH1
	12	HB_CH1
	13	+Sense_CH1
	14	+SUPPLY_CH1
	15	+Sense_CH2
	16	+SUPPLY_CH2
	17	+Sense_CH3
	18	+SUPPLY_CH3
	19	-SUPPLY_CH3
	20	-SUPPLY_CH4
	21	n.c.
	22	+IN_1V_CH4
	23	+IN_1V_CH3
	24	+IN_1V_CH2
	25	n.c.
	26	+IN_1V_CH1
	27	-Sense_CH1
	28	-SUPPLY_CH1
	29	-SUPPLY_CH2
	30	-Sense_CH3
	31	-Sense_CH4
	32	n.c.
	33	n.c.
	34	n.c.
	35	n.c.
	36	-Sense_CH2
	37	n.c.

Last changes

9.1 Error remedies in this version 1.7 Rev 2

Topic	Alteration
Modules power supply	Power supply for the technical datasheets of the modules updated: 10 V to 50 V, except from BRIDGE2, CANSER, C12 and ISO8. Consistent with General technical specs 380: Power supply 10 V to 50 V, DC (modules build before April 2011: 9 V to 32 V, see specification label)

9.1.1 Spec sheet history

CANSAS module	currently released		in previous manual	
	Version	Date	Version	Date
C8	1.4	24.03.2011	1.2	16.07.2009
CI8	1.6	24.03.2011	1.4	30.03.2010
DAC8	1.5	24.03.2011	1.3	28.07.2009
DCB8	1.5	24.03.2011	1.3	19.05.2010
DI16	1.4	24.03.2011	1.2	28.07.2009
DO8R / DO16R	1.5	25.03.2011	1.3	10.02.2011
DO16	1.4	25.03.2011	1.2	14.07.2009
HCI8	1.4	24.03.2011	1.3	19.05.2010
IGN	1.1	25.03.2011	-	-
INC4	1.4	25.03.2011	1.2	16.07.2009
P8	1.5	25.03.2011	1.3	01.10.2009
PWM8	1.4	25.03.2011	1.2	16.07.2009
SC16	1.4	25.03.2011	1.3	20.07.2010
SCI8 / SCI16	1.4	25.03.2011	1.2	16.07.2009
UNI8	1.5	24.03.2011	1.3	19.05.2010

Note

The version number of the technical data has been set back due to a system change. For this reason the version number must be stated in conjunction with the release date.

9.2 Error remedies in version 1.7 Rev 1

Topic	Alteration
CANSAS-L-CI8-V-SUPPLY	Pin configuration rectified

9.3 Error remedies in version 1.7

Topic	Alteration
CANSAS DO8R/16R	The recommended plug is CAN/DSUB-STD (RELAIS), bevor it was ACC/DSUB-REL4 with swapped ON/OFF pins. The previous described plug CAN/DSUB-DOR has been removed.

9.3.1 Spec sheet history

Module CANSAS	currently released		in previous manual	
	Version	Date	Version	Date
DO8R, DO16R 398	1.3	10.02.2011	1.2	14.07.2010
IGN 399	1.0	10.02.2011	-	-

9.4 Error remedies in version 1.6 Rev10

Topic	Alteration
Module supply	Power supply 10 V to 50 V, DC (modules build before 2010: 9 V to 32 V)

9.4.1 Spec sheet history

No changes

9.5 Error remedies in version 1.6 Rev 9

Topic	Alteration
SUPPLY	Sensor supply module: ±15 V changed from 5,7 W to 3 W (also for UNI8 and DCB8)

9.5.1 Spec sheet history

Module CANSAS	currently released		in previous manual	
	Version	Date	Version	Date
HCI8 405	1.3	19.05.2010	1.2	09.03.2010
DCB8 253	1.3	19.05.2010	1.2	11.12.2009
UNI8 333	1.3	19.05.2010	1.2	11.12.2009

9.6 Error remedies in version 1.6 Rev 8

Minor changes

9.6.1 Spec sheet history

Module CANSAS	currently released		in previous manual	
	Version	Date	Version	Date
CI8 238	1.4	30.3.2010	1.3	17.07.2009

9.7 Error remedies in version 1.6 Rev 7

Topic	Alteration
PWM8	Pin 11 labeled with Vcc, previously 5V
LEMO modules	current supply: +SUPPLY and -SUPPLY swapped
INC4	INDEX channel on CON1 only

9.7.1 Spec sheet history

Module CANSAS	currently released		in previous manual	
	Version	Date	Version	Date
BRIDGE2 217	1.2	16.07.2009	1.2	12.11.2007
C8 231	1.2	16.07.2009	1.7	12.11.2007
CI8 238	1.3	17.07.2009	1.10	18.06.2008
DAC8 247	1.3	16.07.2009	1.3	12.11.2007
DCB8 253	1.2	16.07.2009	1.8	23.07.2008
DI16 259	1.2	17.07.2009	1.6	04.02.2008
DO16 263	1.2	14.07.2009	1.4	06.09.2008
DO8R/DO16R 266	1.2	14.07.2009	1.6	04.02.2008
INC4 286	1.2	14.07.2009	1.7	07.10.2008
HCI8 405	1.2	09.03.2010	1.1	26.02.2010
P8 298	1.3	01.10.2009	1.5	02.10.2006
PWM8 313	1.2	16.07.2009	1.5	07.10.2008
SCI8, SCI16, 318	1.2	16.07.2009	1.14	24.06.2008
SC16 318	1.2	16.07.2009	1.8	24.06.2008
UNI8 333	1.2	16.07.2009	1.9	24.06.2008
µ-CAN-V1 355, µ-CAN-V4 375	1.3	02.09.2009	1.3	13.10.2008
µ-CAN-T1 363, µ-CAN-T4 376	1.3	02.09.2009	1.1	22.02.2008
µ-CAN-B1 365, µ-CAN-B4 377	1.3	02.09.2009	1.1	22.02.2008
µ-CAN-HUB4 378	1.2	17.07.2009	1.0	20.02.2008

Note

The version number of the technical data has been set back due to a system change. For this reason the version number must be stated in conjunction with the release date.

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